VIRGINIA CONSERVATION ASSISTANCE PROGRAM IMPLEMENTATION AND DESIGN MANUAL

July 2015

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Introduction

This manual was designed by the Grant Sub-Committee of the Virginia Association of Soil and Water Conservation Districts Urban Committee to assist personnel in participating Soil and Water Conservation Districts (SWCDs) design and carry out the Virginia Conservation Assistance Program, a cost-share program to encourage the use of urban best management practices (BMPs). The Virginia Conservation Assistance Program (VCAP or the "Program") is based upon the North Carolina Community Assistance Program (NCCCAP), modified as appropriate to conform to Best Management Practices (BMPs) accepted by the Virginia Department of Environmental Quality (DEQ). The purpose of this program is to reduce nonpoint source runoff by encouraging non-agricultural landowners to voluntarily implement water quality improvement BMPs. The program also aims to assist localities with the MS4 (Municipal Separate Storm Sewer System) Permit requirements and the challenges meeting the Chesapeake Bay Total Maximum Daily Load (TMDL) goals.

The purpose of this Program Implementation and Design Manual is to be a resource for District staff in siting, selecting, designing, installing, and maintaining retrofit stormwater BMPs. This manual is intended to educate staff members to implement effective stormwater practices through the administration of a cost share program.

Where applicable, this document references the Non-Proprietary BMPs of the DEQ Stormwater Design Specifications contained in the Virginia Stormwater BMP Clearinghouse (http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html). Users will also find the *Virginia Agricultural Cost Share (VACS) BMP Manual* and technical manuals of the Natural Resources Conservation Service (NRCS) helpful for fulfilling the intentions of the program.

The Manual is divided into three parts. Part I summarizes the background and history of the development of VCAP and its administrative framework. Part II contains background information on stormwater and the Chesapeake Bay. Part III contains the design standards for all VCAP best management practice.

PART I – PROGRAM DEVELOPMENT AND IMPLEMENTATION

Section 1.1 Background and Development of the Program

The Virginia Conservation Assistance Program (VCAP or the "Program") was based upon the North Carolina Community Assistance Program (NCCCAP). The assistance and support of the staff of that program is gratefully acknowledged in the preparation of this Manual. Like VCAP, NCCCAP provides financial help to small landowners in urban, suburban, and rural areas to control erosion and runoff on their non-agricultural properties.

NCCCAP is designed to retrofit water quality protective best management practices (BMPs) onto already-developed non- agricultural land. Several districts within the state, particularly Mecklenburg County, broadened their scope of resource protection and developed local community conservation assistance programs, and thus developed model programs potentially applicable across the entire state.

Encouraged by these efforts, the North Carolina Association of Soil and Water Conservation Districts pursued the development of a statewide community conservation program. Through the strong support of district supervisors, the North Carolina Soil and Water Conservation Commission received authorizing legislation to establish the NCCCAP through Session Law 2006-08. The North Carolina Division of Soil and Water Conservation began the program using grant funds to show demonstrable results across the state. In July 2007, the program received its first state appropriation. Over the succeeding five years additional financial support was used to expand the program throughout the state.

Desiring to replicate this successful program, in 2011 the Virginia Association of Soil and Water Conservation District's Urban Committee sought a Chesapeake Bay Small Watershed Project Design Grant from the National Fish and Wildlife Foundation to support the establishment of design components for this Program, focused on filling "urban" gaps identified in Virginia's Watershed Implementation Plan (WIP) for the Chesapeake Bay Total Maximum Daily Load (TMDL). The WIP noted that the "new stormwater regulations will not address sediment and nutrient loads associated with existing development, nor does the existing Chesapeake Bay Preservation Act . . . (To) fill this gap, new requirements, as well as financial incentives for stormwater BMPs are needed."

The Urban Committee's Grant Sub-Committee was primarily comprised of representatives from four Soil and Water Conservation Districts (Districts) -- Culpeper, Hanover-Caroline, Piedmont, and Thomas Jefferson -- all of which played active roles with design of the Program.

The remainder of this Manual is the result of this collaborative work, and is based on the *North Carolina CCAP Program Manual, July 2007* (as partially updated through March 2012) and the *North Carolina Division of Soil and Water Conservation Community Conservation Assistance Program Stormwater Management Practice Design Manual* (no date), and conformed with the Non-Proprietary BMPs of the DCR Design Specifications contained in the Virginia Stormwater BMP Clearinghouse (http://vwrrc.vt.edu/ swc/NonProprietaryBMPs.html) where necessary for Virginia programmatic purposes, as well as to the format and content of the *Program Year 2012*

Virginia Agricultural Cost Share (VACS) BMP Manual.

Section 1.2 Program Scope

The Program will focus its efforts on retrofitting water quality BMPs on existing non-agricultural land uses. It will not be used to assist new development sites to meet state and federal stormwater mandates. Districts have the technical expertise to install water quality BMPs and a successful history of promoting voluntary conservation practices through economic incentives.

The Program Districts have expressed the desire to develop the Program as a cost-effective way to augment the existing Virginia Agricultural BMP Program, and to comply with local, regional, and Chesapeake Bay TMDL requirements that will subsequently be adopted.

Section 1.3 Goals and Objectives of the Program

The overall program goal is to enable owners or managers of non-agricultural land in the Program Districts to install "urban" BMP retrofits that will provide nutrient and/or sediment reductions that can be credited toward accomplishing Virginia's Chesapeake Bay TMDL goals using cost-sharing financial incentives. The Program will accomplish the following objectives to meet the program goal.

A. Maintain a suite of BMPs consistent with the Virginia Stormwater BMP Clearinghouse, as appropriate, and a subset of BMPs appropriate for the Program.

B. Identify environmental benefits associated with BMPs including load reductions associated with Chesapeake Bay TMDL implementation efforts.

C. Maintain BMP specifications that may be required beyond those provided by the Virginia Stormwater BMP Clearinghouse.

D. Maintain partnerships between Districts and local government to ensure local support of the Program.

E. Establish support for the program through partnerships with community groups.

F. Continue to develop and maintain Program information and outreach materials.

G. Identify and establish contacts with other grant programs to maintain strategies to secure continued funding for the Program.

H. Develop and maintain a training curriculum for staff and contractors.

Section 1.4 District Responsibilities

Local implementation of the Program is the responsibility of the participating Districts. The charge for the Districts is to execute the program to satisfy a recognized nonpoint source problem. Districts are to place the highest priority on water quality protection.

A. All Program-related meetings will comply with the Open Meetings Law (Va. Code § 2.2-3707 *et seq.*). Districts will ensure that the District Board meets often enough to properly execute and oversee the Program in their Districts. The Program Steering Committee recommends that District Boards meet to review their Program activities at least six times per year.

B. Each District that chooses to participate in the Program will give public notice of its planned activities preceding the start of each program year and/or when new sources of Program funds become available.

C. Districts will research and develop strategy plans that:
   1. Determine what needs to be done to decrease residential, suburban, and urban nonpoint source pollution.
   2. Areas most critically needing attention will be prioritized.
   3. Assess outreach opportunities and determine marketing approaches.
   4. Prioritize applications based on numerical rankings, using primary and secondary considerations.
   5. Assess staff capability and determine technical and engineering assistance needs.
   6. Follow procedures for tracking and reporting BMP installation and nutrient reduction credits as appropriate.

D. Districts will review and rank applications for funding based on an established schedule.

E. When an application for funding has been approved, the District will approve a design, installation and maintenance plan, which will become a part of the contract with the landowner.

F. When BMPs are installed, District staff with appropriate technical authority, as applicable, will certify that the installation meets the requirements of Part III of this Manual. After certification, contingent on availability, Districts may disburse payment from the Program funds allocated to their Districts.

G. Districts are responsible for conducting annual spot checks of 25 percent (25%) of all active contracts executed in their Districts to ensure on-going maintenance. Districts are to document the number and names of all persons participating in the spot check process. Spot checks will be performed by appropriate technical staff.

H. Districts will ensure that landowners adhere to the maintenance agreement. Landowners found to be out of compliance are notified pursuant to the guidelines found in Part I, Section 1.7 (“Compliance & Corrective Actions”) of this Manual, and documentation of

the noncompliance and resolution becomes a part of the District files. Districts will also ensure that the Program Steering Committee receives notification of noncompliance and the subsequent resolution of such noncompliance.

I. Districts shall ensure that BMP maintenance is continued regardless of transfer of control of property (see Section 1.6).

J. Districts will exercise all jurisprudence to avoid any actual or perceived conflicts of interest in implementing the program.

Section 1.5 Program Steering Committee Role

The role of the Program Steering Committee is to provide programmatic supervision to ensure the program continues to accomplish the overall goal of enabling non-agricultural homeowners to install urban BMPs to reduce the flow of nonpoint source pollution into local waterways and ultimately the Chesapeake Bay. The Steering Committee is also responsible for ensuring continued funding for the Program and addressing any legislative issues that may arise. The Steering Committee will include the following:

A. A representative staff member of each participating District, and

B. The Executive Director of the Virginia Association of Soil and Water Conservation Districts, or his or her representative, and

C. The Chair of the VASWCD Urban Committee.

In order to keep other Districts informed of the progress of the Program and to encourage other Districts to adopt the Program, the Steering Committee will include the Executive Director of the VASWCD and report on that status and progress of the Program to the membership of the Association at least once a year.

Section 1.6 Program Technical Advisory Committee Role

The Program Steering Committee is responsible for creating and maintaining a Technical Advisory Committee (TAC) mainly comprised of Program District technical staff, but could also include other recognized stormwater experts. Membership should consist of at least one representative of each of the participating Districts and other individuals by invitation from the Program Steering Committee. The TAC should meet at least once per year, and may meet at any time appropriate to conduct business for the Program.

The TAC is responsible for evaluating and providing technical advice to the Steering Committee regarding BMPs proposed for inclusion in the Program, to assist the District staff with complicated applications, and ranking applications when money is shared between Districts.

The TAC is encouraged to solicit input by the Program Districts, other Non-Program Districts,

or other specialty organizations or agencies on various issues including types of BMPs, BMP specifications, and average BMP costs. Directors, District staff, DCR personnel, and U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) personnel have a standing invitation to attend TAC meetings and participate in the discussions.

Section 1.7 Funding Allocations, Payments, and Applicant Responsibilities

The Program is currently funded through individual grants garnered by individual SWCDs. All participating SWCDs are expected to contribute financial and staff resources to the Program's administration. Only contributing Districts will receive funding to allocate to property owners within their boundaries.

Payments are made on a reimbursement basis, and applicants are responsible for hiring and paying any contractors used to establish the BMPs. Upon completion of the project, in order to receive payment, applicants must submit all invoices for labor and supplies, sign an Operation and Maintenance (O&M) Agreement, and submit an as-built certification when necessary.

The Operation and Maintenance (O&M) Agreement is a contractual agreement of the applicant to continually maintain the approved BMP for the entire life span of the practice. The applicant is responsible regardless of changes in the control of the land, including the sale of property, as well as, any changes in lease arrangements. In order to be relieved of any operation and maintenance responsibility, the landowner may choose to sign a Transfer of Responsibility form with the new person or entity responsible for the BMP. Participation in the Program does not convey the public's right to access the participant's property.

Maintenance agreements between the involved parties are acceptable but ultimate responsibilities still rest with the applicant. Districts may choose to encourage landowner participation over tenant participation in their information and promotional campaigns.

Section 1.8 Compliance and Corrective Action

Failure to maintain the practice for the specified lifespan will result in the applicant being required to refund all or part of the cost-share amount. The required repayment amount is based on the amount of funding provided to the participant prorated to the lifespan remaining. In the case of the death of the applicant this requirement may be waived. This determination requires an official action of the District Board that must be recorded in the minutes. A Transfer of Responsibility form should be signed if the property changes ownership during the life of the BMP.

Participants found to have practices not meeting specifications or practices destroyed during the designated life span will be contacted by the District and informed of the nature of the deficiency and repayment requirements if not corrected. This should initially be a verbal notice (with the date documented in a case file). Verbal notice should be followed with a written notice (by certified mail) within two weeks. This notice must indicate the observed nature of the problem

and allow the individual the opportunity to respond within two weeks.

Participants may be given a maximum grace period of six months from the date of the written notification for practice compliance. At the end of the grace period, the practice will be re-inspected. The District will notify participants found with practices still not in compliance in writing that repayment of state or other cost-share funds is required.

Participants will have 60 days from the date of the District's notification of repayment to refund the cost-share funds. If restitution has not been made at the end of this 60-day period, the District will notify the Virginia Office of the Attorney General (OAG) for assistance to reclaim the funds. It is recommended that the OAG be apprised of the need for assistance as soon as the deadline for recovery has passed.

PART II –STORMWATER OVERVIEW

Section 2.1 Introduction

The specifications and application of Best Management Practices (or BMPs) are constantly evolving with new information and more experience. The specifications and standards found in this manual will be updated as more research and information is gathered. This document focuses on retrofit BMPs that can be installed in small scale settings, such as existing individual residences and small businesses.

Stormwater BMPs found in this manual:

- **Pet Waste Stations (PWS)** **3.1**
- **Impervious Surface Removal (ISR)** **3.2**
- **Conservation Landscaping (CL)** **3.3**
- **Rain Gardens (RG)** **3.4**
- **Bioretention (BR)** **3.5**
- **Dry Well (DW)** **3.6**
- **Infiltration Basin (IB)** **3.7**
- **Rainwater Harvesting (RH)** **3.8**
- **Vegetated Stormwater Conveyances (VSC)** **3.9**
- **Constructed Wetlands (CW)** **3.10**
- **Permeable Pavement (PP)** **3.11**
- **Green Roofs (GR)** **3.12**
- **Urban Nutrient Management (UNMP)** **3.13**

Section 2.2 Stormwater Overview

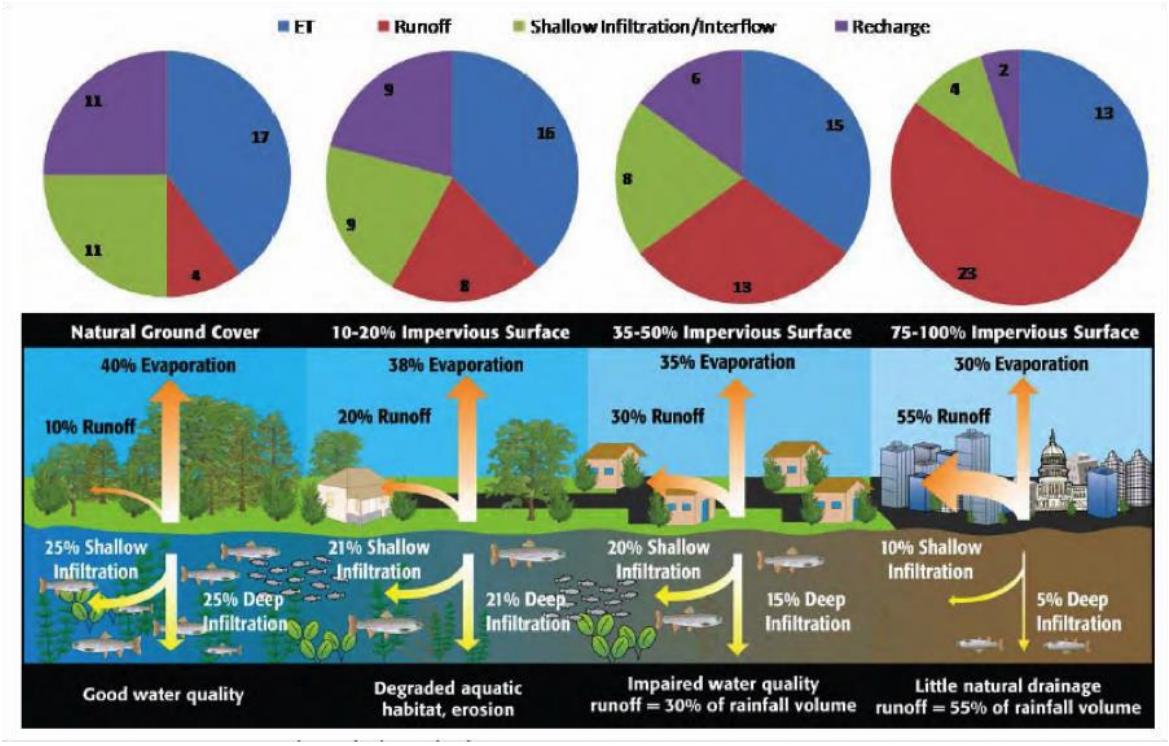
A. Definitions of Stormwater

Stormwater describes surface runoff from disturbed and developed lands that is produced immediately following a rainfall event or as a result of snowmelt. Factors that affect stormwater include the quantity and intensity of a precipitation event, amount of impervious surfaces, the soil type and condition, vegetative cover, and slope length and steepness. The Virginia Stormwater Management Program Permit Regulations at 9VAC25-870-10 define the term as "precipitation that is discharged across the land surface or through conveyances to one or more waterways and that may include stormwater runoff, snow melt runoff, and surface runoff and drainage."

B. Effects of Urbanization

Virginia is among the fastest growing states and the resulting urban influx affects many facets of the state's infrastructure. More cars drive our roads, more people create higher wastewater discharges, and more development necessitates stormwater runoff controls.

How does urbanization affect stormwater runoff? Roads, parking lots, sidewalks, homes, and offices replace the natural, permeable landscape. Rainfall that once soaked into vegetated ground is now available for stormwater runoff. Impermeable surfaces connect to form a "stormwater superhighway" that allows runoff to reach streams more quickly. The following diagram illustrates how stormwater runoff is a function of impervious cover.



Stormwater Runoff as a Function of Impervious Cover (Potomac Conservancy 2008)

There are many impacts from this increase in impermeable area: (1) more stormwater reaches streams because there is less opportunity for it to infiltrate into the ground; (2) peak flows increase because the "stormwater superhighway" transports runoff from large areas rapidly; (3) velocities in the stream increase, causing more erosion; and (4) baseflow is lower during dry weather due to a lack of infiltration into the underlying groundwater (groundwater recharge).

Although Virginia passed legislation to manage stormwater pollution in 2004, sediment remains a major pollutant of our waters. In addition, metals and chemicals from vehicles and industries pollute stormwater runoff in increasing amounts. Likewise, nutrients are found in the urban environment in a variety of forms, such as fertilizer used on lawns and deposition from the air.

Fertilizer contains nutrients for plants to grow, but excess fertilizer or fertilizer that is inadvertently

applied to pavement harms water quality. This manual will provide design guidance for several Best Management Practices (BMPs) that can be constructed to reduce the amount of pollution entering streams.

Section 2.3 Stormwater Best Management Practices (BMPs)

A. Overview of Stormwater BMPs

Stormwater management is the attempt to reduce runoff volume, control peak flow rate and improve water quality using best management practices (BMPs). Each BMP has certain conditions under which it will function properly. Site conditions such as amount of stormwater discharge, soil type, slope, available land, impervious surface, and proximity to waterways all influence the selection of a BMP.

The Environmental Protection Agency (EPA) has identified two distinct classifications of BMPs; "nonstructural" and "structural."

Nonstructural BMPs reduce pollutant generation at the source. There are some simple non-structural practices that homeowners can implement themselves. Some examples include downspout disconnection, sheet flow to open space, grass channels, replacing managed turf with native plants, and soil amendments.

Structural BMPs are engineered systems that control the peak flow, reduce runoff volume, and improve stormwater quality. Some examples of these are bioretention areas, rain gardens, rain water harvesting, green roofs, and constructed wetlands.

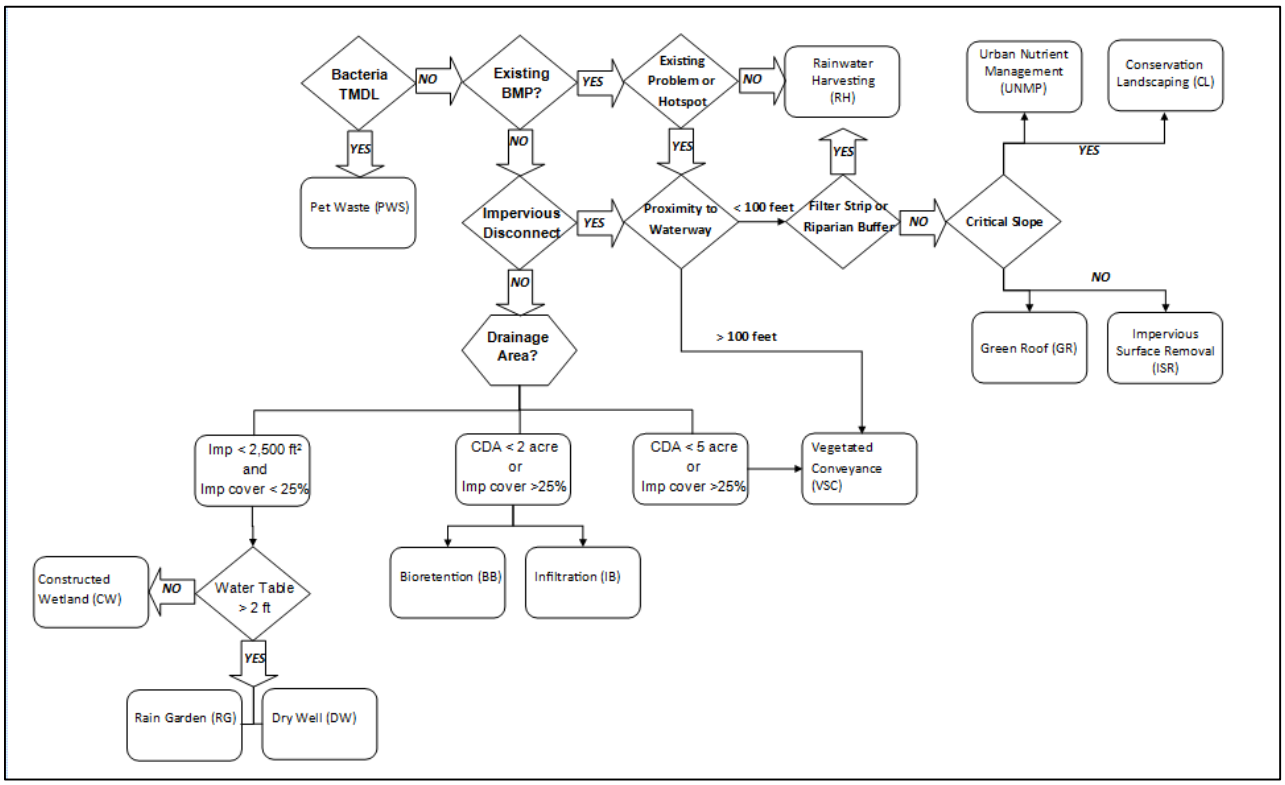
B. Practice Selection

BMP selection will be based on site needs, conditions, or homeowner objectives, and can be very unique depending on the individual landowner's desired outcome. Sites should have a known water quality issue and BMP objectives should be limited to practices that capture and reuse or treat stormwater. Typically, measures to reduce flooding will not be eligible for cost share.

Some Examples:

- Sites with known erosion problems and poor drainage could consider improving the stormwater conveyance system.
- Sites with water volume issues and have an onsite need for water could consider rainwater harvesting to collect and reuse stormwater.
- Sites that produce high levels of pollutants could consider a conversion and land management practices that change how the land is used to reduce pollutant generation.
- A combination of objectives can be satisfied with one or more practices, and practices can be combined to create "treatment trains" to reach all objectives.

The following flow chart may be helpful to determine what practice is appropriate for a particular property.



C. Accounting for Chesapeake Bay Model Credits

Since the first Chesapeake Bay Agreement in 1983, Virginia along with the other states in the Chesapeake Bay watershed have been trying to reduce and reverse the adverse impacts of sediment and nutrient pollution to the Bay. As earlier efforts to reduce point source sediment and nutrient pollutants bore success, efforts have increasingly turned to the growing problem of nonpoint sources of sediment and nutrients as the Bay Agreement was updated in 1987 and 2000 (namely the untreated runoff that results from agriculture and the proliferation of untreated runoff from urban and residential development).

The insufficient progress of cleanup and the continued impairment of the Chesapeake Bay led to the development of a Chesapeake Bay Total Maximum Daily Load (TMDL) for nitrogen, phosphorous, and sediment. Each state within the Chesapeake Bay watershed was required to develop Watershed Implementation Plans (WIPs). The WIPs detailed the strategies each state will implement to meet TMDL allocations (*see Fact Sheet: Chesapeake Bay TMDL, 12/29/10*).

The VCAP BMPs are intended to address Virginia's Phase II WIP strategies and to be accountable for achieving a level of pollution reduction in accordance with the Urban BMPs of the Chesapeake Bay Model (see Sections 6.7 through 6.10). Pollution reduction under the Model is determined based on a BMP's pollutant removal efficiency rate, a pollutant load reduction, or a land use change (see Table 6-4 in Section 6.10 of the Model). Since most of the VCAP BMPs are derived from the Virginia Stormwater BMP Clearinghouse, there is assurance of verification of those BMPs with the Chesapeake Bay Model and accountability towards meeting Virginia's Phase II WIP strategy goals.

Appendix D contains Sheets 3 and 4 of the NPS BMP DET V10 matrix used by the Chesapeake Bay Program to evaluate BMP data elements and an example VCAP project racking spreadsheet.

[Note: A separate VCAP guidance document entitled, "Comparison of VCAP BMPs and Chesapeake Bay Phase 5.3 Community Watershed Model Urban Practices BMPs, with additional input from the Commonwealth of Virginia Chesapeake Bay TMDL Phase II Watershed Implementation Plan (WIP)" compares the existing VCAP BMPs with the Chesapeake Bay Model's discussions of Urban Practices, Shoreline Protection, Land Use Changes, and BMP Annual Time Series (see Model Sections 6.7 through 6.10).

Section 2.4 General Stormwater BMP Design Considerations

2.4.1 Water Quality Treatment

A. The First Flush Concept

The term "first flush" has become common nomenclature in the stormwater management field. The concept behind this term is that pollutants that have collected on impervious surfaces will wash off during the first part of a storm event. The "first flush" contains more pollutants than stormwater runoff produced later in the storm. In theory, if the "first flush" could be captured and treated by a stormwater practice, 90% of the pollutants leaving the site could be treated by the stormwater practice (Schueler and Holland, 2000). The following is from Chapter 5 of the September 2012 Virginia Stormwater Management Handbook which clarifies that the Treatment Volume provides better pollutant removal performance by the BMPs than the "first flush" approach. The TV approach will be emphasized by future stormwater programs in Virginia:

The Treatment Volume is a variation of the first flush concept that is based on a regional analysis of the mid-Atlantic rainfall frequency spectrum. Treatment volume (Tv) becomes the storage volume that stormwater BMPs provide water quality treatment. Treatment Volume is derived from the Simple Method for pollutant load using the 90th percentile rainfall event and the site cover coefficient. In Virginia, the 90th percentile rainfall event is defined as 1-inch of rainfall. The rationale for using the 90th percentile event is that it represents the majority of runoff volume on an annual basis.

The proposed Treatment Volume (T_v) has several distinct advantages when it comes to sizing BMPs for water quality treatment:

- *Storage is a direct function of impervious cover and disturbed soils, which provides designers incentives to minimize the area of both at a site.*
- *The T_v approach provides adequate storage to treat pollutants for a range of storm events. This is important since the first flush effect has been found to be modest for many pollutants (Pitt et al, 2005).*
- *The T_v provides effective stormwater treatment for approximately 90% of the annual runoff volume from the site, and larger storms will be partially treated.*

T_v provides an objective measure to gage the aggregate performance of environmental site design, Runoff Reduction, and Pollutant Removal BMPs together using a common currency (runoff volume).

B. Disconnection

Not all impervious areas contribute substantially to stormwater runoff in a given watershed. Impervious areas that immediately drain to a stormwater conveyance system, such as inlets, culverts, and open channels, are considered to be "connected impervious" areas and produce stormwater that flows untreated to surface water bodies. For example, if a rooftop drains to a gutter, which then drains directly onto a nearby street and into the street storm drainage, this would be considered an example of "connected impervious."

Disconnection occurs when impervious surfaces are redirected and dispersed into sheet flow across an expanse of turf grass or natural vegetation. Runoff from disconnected impervious areas is routed to a pervious area where it has a chance to infiltrate. As a rule of thumb, impervious surfaces must sheet flow for at least 40 feet before it reaches some kind of conveyance system, before it may be considered a disconnected impervious surface for runoff calculation.

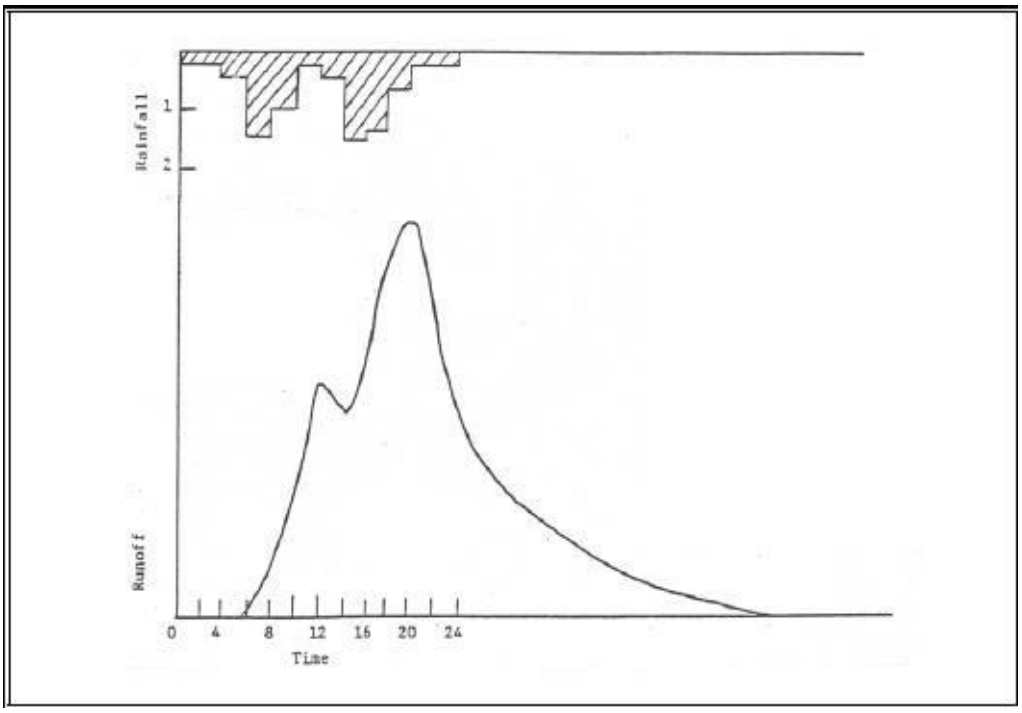
C. Pollutant Load Treatment

The "Simple Method" is a technique that can be used to calculate the anticipated pollutant load that will leave a given residence or small business (Schueler, 1987). The information required to employ the simple method is: (1) area that will be draining to the proposed BMP location in acres, (2) the percentage of the drainage area that is impervious, (3) the annual regional rainfall, and (4) pollutant concentration. The simple method calculates storm intensity in a two-step process using a runoff coefficient to calculate runoff depth (inches), which is then used to determine the annual pollutant load (lbs./year). Instructions on using the Simple Method can be found in Appendix A (Calculations Specific to VCAP BMPs).

2.4.2 Water Quantity Control

A. Peak Flow

Determining the peak flow leaving a watershed during a storm is important when designing many stormwater BMPs. The peak flow is simply the largest flow that leaves the watershed through the course of a storm event. The graph below shows a sample flow versus time relationship and its associated peak flow. The depth of rain that falls throughout the event can be observed on the right side of the graph.



Peak Flow Illustration (Figure 4-4 Virginia Stormwater Management Handbook, Volume 2, 1st edition 1999)

The peak flow is used to determine the capacity of stormwater conveyance systems and size BMP outlet structures. See Appendix A.2 for detailed calculations.

B. Dispersing Stormwater

Stormwater collects and concentrates very easily into depressions, swales, natural runoff conveyances, rain gardens, and rain water cisterns. If possible, backyard stormwater BMPs should have an overflow connection to the existing stormwater drainage pathways. The current drainage path can be utilized as a way to convey water away from the BMP should a storm occur that is larger than what the BMP is designed to hold.

2.4.3 BMP Components

A. Pretreatment and Inlet Control

Pretreatment is a necessary component of many stormwater BMPs. Pretreatment is the process to reduce pollution in stormwater before its introduction into a stormwater BMP. Pretreatment is usually performed to reduce constituents, such as sediment, that may interfere or substantially reduce the effectiveness of a stormwater BMP Pretreatment requirements for stormwater BMPs covered by the Program can be found in Appendix B.

B. Outlet Structure

Close attention should be paid to where the water from a stormwater BMP exits a given property. During small rain events, depending on soil conditions all the stormwater produced in a small watershed may be retained in the BMP. However, during larger rainfall events the stormwater BMP will fill to capacity and spill over into the adjoining area.

There are three types of outlets to consider: underdrains, orifices, and weirs. An underdrain is a perforated pipe that collects excess water from a filtering practice and is typically connected to a storm sewer system or 'daylighted" into a conveyance system. An orifice is a part of a control structure that includes a riser and barrel through an earthen embankment. Orifice outlets typically connect to a storm sewer system or daylights into a conveyance system. A weir is notch in the earthen embankment similar to an open channel. Weirs can be a vegetated, stone or concrete and typically discharges runoff overland as sheet flow. Selection of an outlet is dependent on the stormwater BMP and location of an adequate conveyance system.

Special care should be taken to ensure that the area into which the outlet discharges is able to convey the stormwater safely to a nearby conveyance system, such as an inlet, culvert or open channel. The procedure for determining the appropriate outlet size can be found in Appendix A.3

2.4.4 Compliance with Local, State, and Federal Codes

The type, size and location of the BMP may require compliance with local zoning ordinances and local, state and federal permitting. A joint permit application (JPA) should be submitted when impacting wetlands and streams. If the size of the BMP disturbs enough land to qualify as a land disturbing activity, then a local land disturbing permit may be needed. These BMPs must comply with the local program ordinance and the Virginia Erosion and Sediment Control Regulations (9VAC25-840*et seq*.).

A. Riparian Buffers

Riparian buffers help to absorb periodic flood surges; supply thermal protection, food, and cover to fish and other wildlife; stabilize stream-banks; filter runoff; and provide recreation and aesthetic values.

Riparian buffer rules in certain localities can impact the function and siting of a backyard stormwater BMP. All applicants should confer with their local governments, as well as their local Soil and Water Conservation District, to determine if proposed BMPs may be impacted by local riparian buffer requirements

2.4.5 Considering Soil Conditions

Stormwater BMPs are impacted significantly by the soil in which they are constructed. Therefore, it is important to know which soil types are present at a given location before designing or constructing a stormwater BMP. The presence of restricted layers such as shallow bedrock, high water table, and compacted clay may affect construction and design of stormwater BMPs. Soil properties such as hydraulic conductivity, texture, and linear extensibility affect site infiltration rates. Soil nutrient levels (N-P-K), pH and cation-exchange-capacity (CEC) affect vegetation establishment. When a site is evaluated for BMP implementation, determining the soil type at the site can be performed first by referring to soil surveys for general soil characteristics and, more importantly, from field reconnaissance by a qualified soil scientist.

A. Soil Surveys

Soil Surveys are comprehensive reports on soil resources of a given county. These publications

include maps with soil boundaries, aerial photos, narrative descriptions of each soil map unit and tables explaining specific soil properties and features. District staff should become familiar with the soil survey of their particular counties. It is important to note that soil surveys may not be accurate to the site scale level.

B. Site Investigations

Soil information gathered solely from a soil survey should not be used exclusively to determine which type of soil is present at a given site. A site investigation is needed to verify that the soil on site is suitable for a given BMP, especially those intended to provide infiltration. Infiltration information can be gathered by digging a test hole in the location of the proposed BMP that is approximately 2-foot deep, or to the depth of the bottom of the proposed BMP, whichever is deeper. As the hole is being dug, the soil should be observed for signs that it is a wetland soil. Wetland soils are commonly grey with ribbons of brown. If wetland soils are identified within 1 foot of the surface at a given site, the site is likely poorly drained. A detailed description of wetland soils is available in Vepraskas (1999).

The last evaluation that should be used during the site investigation is a simplified soil infiltration test. This is a test to check the permeability of the soils being evaluated for BMP suitability. A hole should be dug using an auger or spade, approximately 1 foot below the expected bottom of BMP. The newly dug hole should be filled with water. Monitor how quickly the hole drains and use this information to select the appropriate BMP. The drainage rate is particularly important for plant selection and bottom grading of the practice.

2.4.6 Maintenance

Once construction is completed, periodic inspections must be performed to ensure the BMP continues to function as designed. Maintenance is a necessary component of all BMPs.All applicants must be aware of the operation and maintenance responsibilities for the proposed BMP. These responsibilities, as noted in the BMP-specific Operations and Maintenance (O&M) Agreements (*see* Appendix C), may influence BMP selection. District Staff should discuss the following maintenance requirements with all applicants:

A. Routine Maintenance

Routine maintenance may include landscaping and aesthetic maintenance such as grass, tree and shrub care, wetland plant care, re-seeding and mulching, slope stabilization, grass mowing, pruning, filling and repair of gully erosion, repair of shoreline, animal control caused by nuisance rodents, removal of invasive vegetation and minor sediment cleaning. It also may include removal of debris, trash, sediment, vegetation and other matter that impedes or threatens to impede stormwater functioning or structural integrity.

B. Non-Routine Maintenance

Non-routine maintenance may include the repair or replacement of structural components such as embankments, risers and outlet barrels, trash racks and anti-vortex devices, emergency spillways, pretreatment forebays, seepage controls, drains, water quality or quantity control devices, outlet protections or energy dissipaters, shoreline stabilization, and major sediment removal (excavation

or dredging methods).

2.4.7 **Problems Regarding Multiple Property Owners**

Before a site is chosen for a backyard stormwater BMP, the property boundaries must be clearly defined by property owner and verified by District staff. This is to ensure that no part of the stormwater BMP is sited on property belonging to an individual not participating in the Program. If a stormwater BMP is to be sited in such a way that multiple property owners will be impacted, all property owners must be contacted and must agree upon the BMP measures in the project contract.

Additionally, stormwater BMPs are designed to slow and capture stormwater as it leaves a given property, thus a pool of water may form as water slows and enters the BMP. This pool of water should not extend to a neighbor's property without written consent in the project contract. It should also be noted that downstream property owners usually benefit from their upslope neighbor's installation of backyard BMPs, which bring about a potential reduction in flooding and erosion on the downstream owner's property. This benefit should be clearly communicated to the non-participating landowners as part of the development of the BMP project.

PART III: New Retrofit BMPs

Section 3.0 All VCAP BMPs

The VCAP BMPs are organized in this manual by their general increase in complexity as a result of their generally increasing engineering and construction requirements.

Basic practices generally require no engineering in their installation and minimal planning. As a result they can generally be planned and installed by an applicant with minimal Soil and Water Conservation District (District) assistance. Intermediate practices require more extensive planning and in some instances some engineering and thus may require the applicant to hire a skilled contractor with some engineering expertise. Specialized job approval certification may be necessary for the District personnel assigned to the project. Advanced practices are the most complex, in almost all cases requiring extensive planning, the hiring of a skilled contractor and engineer, and specialized District staff certification.

As a guideline, the following is the assigned level of complexity of VCAP BMPs:

Basic BMPs
-- Pet Waste Stations
-- Impervious Surface Removal
-- Urban Nutrient Management Planning
Intermediate Level BMPs
-- Conversion Landscaping
-- Rain Gardens
-- Dry Well
-- Rainwater Harvesting
-- Vegetated Stormwater Conveyance
Advanced BMPs
-- Bioretention
-- Infiltration Basin
-- Constructed Wetlands
-- Permeable Pavement
-- Green Roofs

Policies Regarding All Practices
Detailed standards for each BMP are discussed in subsequent sections of this chapter. Where applicable, these BMP standards were based on the specifications of the Virginia Stormwater BMP Clearinghouse and to be consistent with the Chesapeake Bay TMDL Watershed Implementation Plan (WIP). All Districts have the discretion to use the Retrofit curves on an as needed basis, when a practice cannot meet the Clearinghouse specifications. Below are the design standards that pertain to all practices.

A. Eligibility

- Practices are not intended to meet regulatory requirements. Sites must be released from any existing erosion and sediment control (or land-disturbing) permits or regulatory programs and construction completed prior to applying.

- Practices funded through this program cannot be used for Nutrient Trading.

B. Lifespan Requirements of VCAP Projects

- Urban Nutrient Management Plans expire after 3 years.
- Pet Waste Stations must be maintained for 3 years.
- All other practices must be maintained for 10 years.
- Once installed, projects should be considered permanent landscape features and an effort should be made to provide for continuation beyond the program commitment.

C. Primary Ranking Criteria for VCAP Funding

- Presence of Existing BMP Treatment (YES/NO)
- Impervious Area or Treated Area (acres)
- Disconnection (greater than 40 feet to conveyance system or impervious cover and less than 5 % slope gradient) (YES/NO)
- Pollutant Load Removal (lbs)
- Potential Utility or Site Constraints (LOW/MED/HIGH)
- Property Ownership (PRIVATE/PUBLIC/ROW)
- Existing Drainage Problem or Hotspot (YES/NO)
- TMDL Watersheds (BACTERIA/SEDIMENT)
- Accessibility (LOW/MED/HIGH)
- Educational or Outreach Opportunity (YES/NO)

D. Plans and Specifications

- **The applicant is responsible for ensuring that the proposed project and subsequent maintenance meets all applicable local, state and federal permits, policies and ordinances.**
- After board approval and prior to initiating construction, a final plan must be submitted and shall include the following:
    - Sketch showing the location, specifications, contributing drainage area, impervious areas treated, and dimensions of the practice
    - Cross section showing the depth, slope, and inlet, outlet and overflow structures where applicable
    - Material Lists and Cost Estimate
    - Site constraints for construction should be identified.
    - Distance to watercourse or drainage structures.
    - Necessary computations per the practice standards
    - Other information as requested by the local SWCD

E. Operation and Maintenance

- All practices will be subject to spot checks by SWCD staff during the practice's lifespan.
- Landowner (or applicant) must accept maintenance responsibilities for the practice per an approved Operation and Maintenance (O&M) Agreement (see Appendix C). This agreement will include specific maintenance objectives described for each BMP.

F. Technical Responsibility

- The applicant will be responsible for submitting all project plans. Technical guidance may be provided by local SWCDs. All projects must meet local codes, ordinances, and policies, and must address any permitting requirements.
- The local SWCD is responsible for reviewing all plans, providing any necessary technical guidance, and inspecting the completed practice to ensure that all standards have been met prior to issuance of payment.
- District staff that provides assistance and approval of projects must have a basic understanding of nonpoint source pollution and pollution reduction in Virginia.
- A licensed or certified professional is responsible for certifying an accurate as-built plan per original design for any intermediate and advanced practices.

G. Cost-Share Incentives

- If a practice requires a pre-treatment then the pre-treatment costs are included in the primary practice costs.
- If a practice does not require a pre-treatment, any pre-treatment provided may qualify for additional funding.

H. Planning Considerations

- Infiltration test:
  - Dig hole to depth of proposed practice
  - Fill with known amount of water
  - Time how long it takes to drain (gallons/hour) over a 48 hour period
- Soil Testing
- Miss Utility notification (Call 811).
- Setbacks from dwellings, septic and wells shall follow guidelines per the practice standard.

Section 3.1 Pet Waste Stations (PWS)

Typical Pet Waste Station

The Environmental Protection Agency estimates that the typical dog produces three-quarters of a pound of waste per day. Left alone, pet waste can pollute ground and surface water, attract flies and pests, and transmit parasites and infectious diseases. Pet waste stations are designed to encourage pet owners to pick up after their animals in parks and other public places to prevent waste from being transported off-site by stormwater runoff. As illustrated above, pet waste stations typically include a covered 10-gallon waste can and plastic or bio-degradable "pick-up" bags attached to a sign-post that identifies the station purpose, and are installed at convenient locations where pet-walking and pet exercise occurs. However, where trash receptacles are already deployed in a public area, the waste cans are not an essential component of this BMP.

Policies Regarding PWS

Pet Waste Stations have relatively few practice constraints other than ensuring that the receptacles are located at places where pet owners are likely to have need of their services, they can be serviced and maintained by available staff, and the ultimate disposal facility will not of itself cause a water quality problem by concentrating the pet waste in a watercourse or in groundwater.

A. Screening Factors

- Concentration of pets in the community, determined by population density (dwelling units per acre)
- Proximity to drainage conveyance systems
- Bacteria TMDL watershed
- Educational potential

B. Criteria

- This practice should only be installed in public areas such as parks, neighborhood common

areas, apartment complexes, and similar public areas that are easily accessible and visible to pet walkers. This practice is not designed for the individual homeowner.

- Receptacles should be safely located away from areas used for access by public utility service vehicles and must be at least 100 feet from water conveyance systems.
- Each station must have a professionally designed sign describing the use and purpose of the station. Most commercial stations come with this type of sign.
- The waste disposal site will not of itself cause a water quality problem by its location to a watercourse or groundwater supply.

C. Plans and Specifications

- A final design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the plan includes:
  - Location within the property on a site map
  - Site preparation details
  - Provide Manufacturer specifications for installation, such as depth of posts and foundation materials
  - If a trash can is included in the design, include a waste disposal plan

D. Operations and Maintenance

- At least weekly service and maintenance for all stations that include a waste receptacle.
- Refill waste bags as necessary.

E. Cost-Share Rates

- After the initial purchase of the station, VCAP will not provide assistance for waste bags.
- Reimbursement will be paid at 75 percent of costs up to a maximum payment of $400.00 per application.

F. Helpful Technical Reference

- http://www.annapolisgreen.com/pdf/PetWasteStationCommProgHowToGuide.pdf

Section 3.2 Impervious Surface Removal (ISR)

Impervious surfaces are covered by impenetrable materials such as asphalt, compacted gravel, concrete, brick, and stone. These materials seal surfaces, repel water, and prevent precipitation from infiltrating soils and groundwater. Removal of these impervious materials, when combined with permeable pavement or vegetation establishment, is intended to reduce stormwater runoff rate and volume, as well as associated pollutants transported from the site by stormwater runoff.

The process of urbanization, characterized by increases in impervious areas, causes a substantial increase in stormwater runoff. One obviously beneficial stormwater management practice is to reduce the amount of impervious surface area in a given urbanized area. If an area has already been urbanized, this can be accomplished by removing impervious areas that are no longer needed.

Patios, walkways, parking areas, and driveways can all be removed and converted to pervious areas that increase infiltration to groundwater. Gardens, lawn, and permeable pavements all can be used in place of the impervious area removed. In order for impervious surface removal costs to be offset by the Program, they must be accompanied by an approved stabilization plan.

Policies Regarding ISR

A. Screening Factors

- Filter Strip or Riparian Buffer potential
- Proximity to Drainage Conveyance
- Existing Drainage Problem or Hotspot
- Disconnection potential

B. Criteria

- The practice must include a plan for vegetation establishment or permeable pavement installation.
- When vegetation is to be established on site, the practice should be initiated as closely as possible to the optimum time for vegetation establishment. Temporary conservation cover must be established within 14 calendar days if permanent vegetation cannot be established. Vegetation establishment must include proper soil preparation, which may require a soil test. Deep tillage using a chisel plow, ripper or sub-soiler may be required to address soil compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper seedbed establishment.
- Removal must include the impervious surface and sub-grade aggregate. The materials removed must be properly disposed.
- Temporary conservation cover must be established within 7 calendar days of impervious surface removal, if permanent vegetation cannot be established.

- An Erosion and Sediment Control Permit may be required.
- This BMP is not intended for impervious surface removal associated with roof removal.

C. Plans and Specifications

- A planting/design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
  - Total impervious surface area to be removed and detailed map of the site.
  - A plan for fragmenting, removal and disposal of existing impervious cover.
  - A plan for soil preparation, which must be supported by a soil-test.
  - A plan for final site stabilization.
  - Expected timeline for completion.
  - Erosion and Sediment Control Plan, if applicable

D. Operation and Maintenance

- Site specific maintenance items depending on final stabilization plan.
- Ensuring full vegetative cover remains intact and invasive species are controlled if vegetation is used.
- No impervious surface built over the treated area

E. Cost-Share Rates

- The Program will reimburse up to $2.50 per square foot of treated area up to a maximum payment of $10,000.00.

F. Helpful Technical References

- Conservation Landscaping BMP in this Manual (see Section 3.3 below).
- Permeable Pavement BMP in this Manual (see Section 3.9 below)
- Virginia Stormwater Clearinghouse Design Specification No. 4 Soil Amendments http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Virginia Erosion and Sediment Control Handbook Standard and Specification 3.30 – Topsoiling. http://www.dcr.virginia.gov/stormwater_management/e_and_s-ftp.shtml

Section 3.3 Conservation Landscaping (CL)

This practice encompasses the conversion of turf grass areas or bare soils to native planted areas – herbaceous and woody species. Changing landscape practices collectively in a community can have significant beneficial impacts on local water quality and that of the Chesapeake Bay.

Native plants are generally best adapted to local soil and climate conditions and therefore require the least amount of nutrient addition or cultivation in order to maintain the amount of ground cover best suited to minimize runoff. In contrast, turf grasses and non-native species generally require both continual maintenance and periodic fertilization in order to provide the same amount of stormwater runoff protection. Therefore, the addition of native plants will generally be beneficial to the protection of water quality from nonpoint source runoff pollution.

The nutrient load of a residential lawn (.2 acres) has been estimated at approximately 1.6 lbs./year of nitrogen and 0.23 lbs./yr. of phosphorus (*ref. Rappahannock River Friendly Yard Brochure, Rappahannock River Basin Commission, July 2012*).

Natural Meadow Turf to Native Plant Management

Policies Regarding CL

There are three conservation landscaping practices covered under this standard; Meadow, Tree Planting, and Landscaped Mulched Bed.

A. Screening Factors

- Critical Slope (>15%)
- Proximity to streams and Conveyance System (<100 ft.)

- Use of proposed planting as a Filter Strip or Riparian Buffer

B. Criteria

- Mowing of the planted area shall be limited according to the approved maintenance plan described in the O&M Agreement.
- This practice should be initiated as closely as possible to the optimum time for vegetation establishment. Temporary conservation cover must be established within 14 calendar days if permanent vegetation cannot be established.
- Vegetation establishment must include proper soil preparation. Deep tillage using a chisel plow, ripper or sub-soiler may be required to address soil compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper seedbed establishment.
- Perennial native species that are adapted to the site conditions must be used. Therefore, selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame to stabilize the site sufficiently to permit suited uses with ordinary management activities. Invasive or noxious species are prohibited. Plant species must be considered "Flora of Virginia", see *Helpful Technical References* section for publications and websites related to native plants.
- A meadow should include a seed mix with at least two (2) native grass species and nine (9) forbs/wildflower species. Competition controls must be included with the final plans. Competition controls are described in more detail in the site specific plan. A temporary cover is necessary when there will be two burn downs.
- Tree plantings are intended to be native species. Diversity is encouraged for larger scale projects. Appropriate tree protection measures must be employed, such as tree shelters, weed barriers, tree wraps, or other methods approved by the local SWCD.
- Landscaped Mulch Beds must include aged, double shredded wood mulch at least 3 inches thick. Landscape edging (6 inch deep) is required when adjacent to invasive ground cover and impervious surfaces.
- Required density and minimum ground covers for all plantings will be based on approved site specific plans. See VDOF recommendations for tree plantings in the *Helpful Technical References* section.
- Fertilization, mulching, or other facilitating practices for plant growth must be timed and applied to accelerate establishment of selected species, and must not be a requirement for vegetation maintenance. Soil amendments will be added only as demonstrated necessary according to a soil test report.
- Measures to exclude pests that will interfere with the timely establishment of vegetation must be employed.
- If the planting area is to serve as a *filter strip or Riparian Buffer* for uphill land that is more intensively managed, the following criteria should be followed:
  - A robust stand of vegetation should be established.
  - Slope gradient shall be less than 8 percent.
  - Minimum width of 35 feet for slope gradients less than 4 percent. Minimum width

of 50 feet for slope gradients 4 to 6 percent. Minimum width of 65 feet for slope gradients 6 to 8 percent.
- Runoff onto the strip should be evenly dispersed with an adequate pretreatment measure. See appendix B
- Contributing drainage areas should be less than five acres.

C. Plans and Specifications

- A planting/design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
  - Type of Conservation Landscaping.
  - Square footage of the area being planted.
  - Linear feet of stream being buffered (if applicable).
  - Total drainage area of the site and the amount of impervious surface draining to the project. Only applicable for Filter Strip and Riparian Buffer applications.
  - Slope of the land.
  - Plan to control and/or eliminate unwanted existing vegetation.
  - Landscape planting and mulching plan including: species, rate of seeding or planting, minimum quality of planting stock and method of establishment. Only viable, high-quality seed or planting stock should be used. Soil types and any required soil amendments as a result of a soil test. Include the amounts, timing and method of application of each amendment.

D. Operation and Maintenance

- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Annual survey of planted area to evaluate for invasive species and plant survival/success. For the first two years, trees must have a 75 percent survival rate with an overall survival rate of 50 percent. Meadows must maintain a cover of 75 percent or more.
  - If invasive species are present (according to: www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf), remove to reduce invasive cover ground cover to less than 5%.
  - Tree and shrub mortality will be addressed annually by replanting the species with adequate protection and support to ensure survival.
  - Trash should be removed at least annually.
  - Issues of trespass, leading to damaged vegetation, will be addressed as necessary.

E. Cost Share Rates/Incentives

- Meadows and landscaped mulch beds will offer incentive payments of up to $250.00 per

1000 square feet of area planted.

- Tree-planting projects will offer payments of up to $9.00 per tree.
- Payments will not exceed total cost of the project with a maximum payment of $3,500.00.
- Only one cost-share rate can be applied per planting area.

F. Helpful Technical References

- USDA NRCS Conservation Cover: Wildflower Meadow for Wildlife and Pollinators. Virginia Conservation Practice Job Sheet 327 (a). 2007.
- USDA NRCS Riparian Forest Buffer. Conservation Practice Job Sheet 391. 1997.
- Dorner, Jeanette. An Introduction to using native plants in restoration projects. National Park Service. 2000. www.nps.gov/plants/restore/pubs/intronatplant/index.htm
- http://www.itreetools.org/index.php
- http://www.epa.gov/greenacres/toolkit/index.html
- http://www.prairiemoon.com/growing-your-prairie/growing-your-prairie.pdf
- VDOF Tree planting recommendations: http://www.dof.virginia.gov/tree/care/index.htm
- Alliance for the Chesapeake Bay Stormwater:

http://stormwater.allianceforthebay.org/take-action/structural-bmps/conservation-landscaping/

http://stormwater.allianceforthebay.org/take-action/structural-bmps/native-meadow/

http://stormwater.allianceforthebay.org/take-action/structural-bmps/tree-planting/

- Native Plant Resources:
  - Native Plant Center (ACB): http://www.nativeplantcenter.net/
  - Digital Atlas of the Flora of Virginia: http://vaplantatlas.org/
  - Flora of Virginia Project: http://floraofvirginia.org/
  - Native Plants for Conservation, Restoration & Landscaping – Piedmont Region http://www.dcr.virginia.gov/natural_heritage/documents/pied_nat_plants.pdf
  - Native Plants for Conservation, Restoration & Landscaping – Buffer Zones http://www.dcr.virginia.gov/natural_heritage/documents/riparian_nat_plants.pdf
  - Albemarle County Native Plant Database: http://www.albemarle.org/nativeplants/

Section 3.4 Rain Gardens (RG)

A Rain Garden is a shallow landscaped depression that incorporates many of the pollutant removal mechanisms that temporarily ponds runoff 6 to 12 inches above the mulch layer and then infiltrates into the underlying native soil.

A Typical Rain Garden

These practices designed to treat runoff from small areas, such as individual rooftops, driveways and other on-lot features in single-family detached residential developments. Inflow is typically from a downspout with energy dissipaters or can be sheet flow from a driveway/patio or lawn.

Policies Regarding RG

A. Screening Factors

- TMDL watersheds may be given priority depending on the pollutant(s) of concern to the TMDL.

B. Criteria

- Runoff should be captured within 40 feet of downspout or impervious surface.
- The site must have soils capable of infiltrating stormwater runoff or the applicant must be willing to amend the soil. If the need for soil replacement or underdrain is identified the applicant should consider a bio-retention practice.
- Rain gardens will not be placed in wetland soil or within the 100-year flood plain.
- Project drainage areas less than 10,000 sq. ft. will not contain more than 2,500 sq. ft. of impervious surface cover. Project drainage areas over 10,000 sq. ft. will not contain more than 25% impervious cover.
- Rain gardens should retain water for less than 48 hours after a storm event.

- Depth to water table and bedrock shall be greater than 2 feet.
- Impact from proposed rain garden location on septic drain fields and foundations should be evaluated prior to application approval.
- A stable stormwater overflow route must be provided.
- When concentrated stormwater is routed into a rain garden, an energy dissipater must be provided that will prevent scour of the rain garden.
- All vegetated areas that drain to the rain garden must be maintained in full vegetative cover with no scour areas.
- Planting and mulching and all other site stabilization measures must occur immediately after constructing the rain garden. Seasonal exceptions can be made

C. Plans and Specifications

- A planting/design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
    - Results of a percolation test (see Section 3.0 for infiltration test details)
    - A detailed plan showing dimensions, depth, and square footage of the rain garden.
    - Total drainage area of the site, the amount of impervious surface draining to the project, and calculation to determine rain garden is sized properly.
        - Use the following equation from the *Virginia Department of Forestry Rain Gardens Technical Guide* to determine minimum rain garden size:

Impervious Surface (sq.ft.) x 0.063 = _____ sq.ft.
Pervious Surface (sq.ft.) x 0.0175= _____ sq.ft.
Total Rain Garden Size Required = _____ sq.ft.

    - Slope of the land
    - Installation requirements and sequencing.
    - Landscape planting and mulching plan including: species, rate of seeding or planting, minimum quality of planting stock and method of establishment. Only viable, high-quality seed or planting stock should be used.
    - Distance to watercourses or drainage structures (along flow path).
    - Existing vegetation to be kept in the new landscape.
    - Soil types and any required soil amendments as a result of a soil test, such as compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.
    - A plan for full site stabilization.
    - A statement regarding compliance with any permitting requirements.

D. Operation and Maintenance

- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
    - Annual survey of planted area to evaluate for:
        - invasive species
        - plant survival/success
        - ensure all vegetation stabilization measures remain intact
        - runoff flow routes function
    - If invasive species are present (according to: www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf), remove to reduce invasive cover ground cover to less than 5%.
    - Tree and shrub mortality will be addressed annually by replanting the species with adequate protection and support to ensure survival.
    - Reapply wood mulch as needed.
    - Trash should be removed at least annually.

E. Cost-Share Rates/Incentives

- Reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $2,000.00 per application.
- Incentive payments will be paid to the applicant (landowner) following approval of installation by the local SWCD.

F. Helpful Technical References

- *Rain Gardens Technical Guide – A Landscape Tool to Improve Water Quality*
  - *Virginia Department of Forestry*
  http://www.dof.virginia.gov/print/mgt/Rain-Gardens-Tech-Guide.pdf
- Hunt, Bill. Bioretention/Rain Garden: Hydraulic and Hydrologic Design Worksheet, NCSU http://www.aces.edu/waterquality/streams/Bill's%20Handouts/bioretention%20design%20worksheet.pdf
- Virginia Stormwater BMP Clearinghouse Design Specification No. 1 and No. 9 http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Rain Garden Landscape Templates for the Mid-Atlantic http://www.lowimpactdevelopment.org/raingarden_design/
- Virginia Cooperative Extension Urban Water Quality Management Rain Garden Plants. Pub 426-043 https://pubs.ext.vt.edu/426/426-043/426-043_pdf.pdf
- Fairfax County Rain Garden Manual http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf
- Alliance for the Chesapeake Bay Stormwater http://stormwater.allianceforthebay.org/take-action/structural-bmps/rain-gardens/

Section 3.5 Bioretention (BR)

A Typical Bioretention Practice Treating a Commercial Rooftop

Bioretention as a practice is a shallow landscaped depression that temporarily ponds runoff 6 to 12 inches above the mulch layer and then filters through an engineered soil media prior to discharging to an underdrain or infiltrating into the underlying native soils. Bioretention practices typically treat parking lots, multiple lots and/or commercial rooftops. Inflow can be either sheet flow or concentrated flow. Bioretention should be located in common area or within drainage easements, to treat a combination of roadway and lot runoff. Bioretention used on individual residential lots is commonly referred to as a *Rain Garden* and is covered in Section 3.4 above.

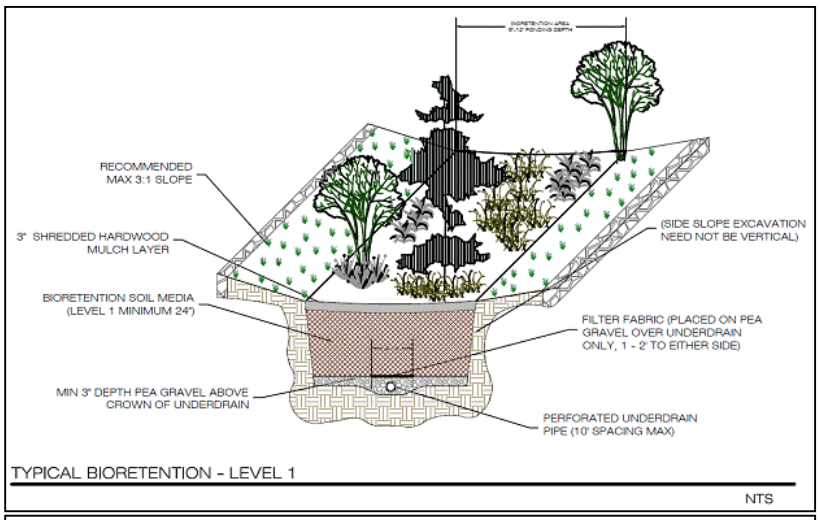
A typical bioretention practice is shown in the photograph below. Bioretention may also be self-contained structures such as expanded tree pits, curb extensions, and foundation planters located in ultra-urban developed areas such as city streetscapes.

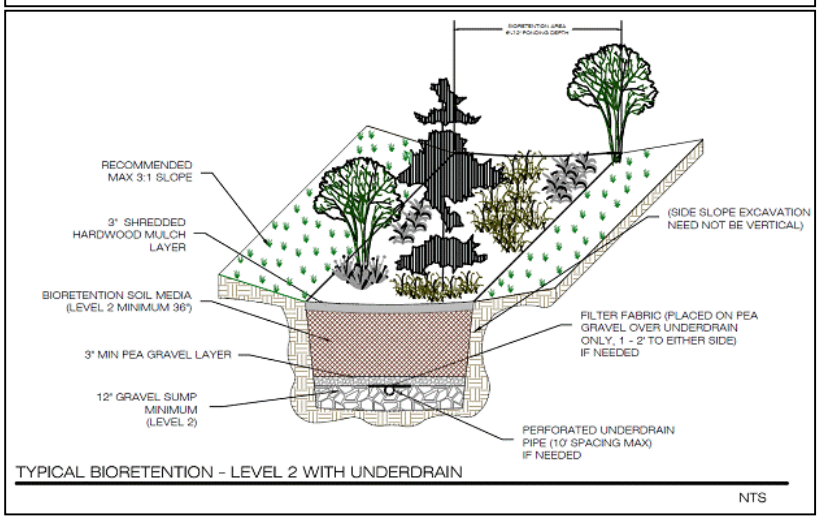
The primary component of the bioretention practice is the engineered soil media, which has a mixture of sand, soil, and organic material as the filtering media with a surface mulch layer. The underdrain consists of a perforated pipe in a gravel layer installed along the bottom of the filter bed.

The major design goal for bioretention is to maximize runoff volume reduction and nutrient removal. To this end, a bioretention basin is considered a baseline design (Level 1) BMP or choose an enhanced design (Level 2) that maximizes nutrient and runoff reduction.

The Virginia Stormwater BMP Clearinghouse, DCR Stormwater Design Specification No. 9 Bioretention, should be used for planning and design details. Some things to consider include:

- Geometry
- Pre-treatment
- Filter media & surface cover
- Underdrain & underground storage layer
- Bioretention planting plans





Policies Regarding BR

A. Screening Factors

- TMDL watersheds may be given priority depending on the pollutant(s) of concern to the TMDL.
- Implementation of a Level 2 design that infiltrates into the surrounding native soils.

B. Ranking and Priority

- Sites that drain directly into storm sewers without any other BMP treatment should be given priority.
- Sites that drain via pipes or culverts into existing BMPs should be given secondary priority based on an evaluation of the existing BMP.
- Sites that sheet flow to adjacent pervious land will be given low priority based on an evaluation of adjacent pervious land.

- TMDL watersheds may be given priority depending on the pollutant(s) of concern to the TMDL.
- The value of educational use of the site will be considered.
- Implementation of a Level 2 design will be considered.
- Likelihood the project will remain beyond the program contract lifespan.

C. Criteria

- This BMP is intended to treat impervious surface areas greater than 2,500 square feet, and with a contributing drainage area of less than 2 acres.
- Bioretention practices will not be placed on wetland soils or in the 100 year flood plain.
- Ponded water should be retained no longer than 48 hours. Ensure that there are appropriate numbers of underdrain pipes and that they are adequately sized to meet this criterion.
- Underdrains may be removed when the soil infiltration rate has been confirmed to be adequate.
- Appropriate pretreatment practices shall be provided. See appendix B.
- The designer should provide for relief from the storm event specified by local ordinance or for the 25-year storm event, whichever is the most stringent.
- A stable stormwater overflow must satisfy Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations and Virginia Stormwater Regulations.
- Engineered soil media, landscaping and other criteria as referenced in Virginia Stormwater BMP Clearinghouse Design Specification No. 9. Landscaping shall include one (1) tree per 250 square feet of ponding area with a shrub to tree ratio of 3 to 1. Appropriate density of perennials shall be planted as in-fill.

D. Plans and Specifications

- **A licensed professional design certification and as-built certification is required.**
- A planting/design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
    - Site map illustration location on property
    - A detailed plan showing dimensions, depth, and square footage of the bioretention.
    - Total drainage area of the site and the amount of impervious surface draining to the project.
    - Results of a percolation test (see Section 3.1 for infiltration test details).
    - Slope of the land.
    - Linear feet of stream being buffered (if applicable).

- Installation requirements and sequencing.
- Distance to watercourses or drainage structures (along flow path).
- Existing vegetation to be kept in the new landscape.
- Landscape planting and mulching plan including: species, rate of seeding or planting, minimum quality of planting stock and method of establishment. Only viable, high-quality seed or planting stock should be used.
- Soil types and any required soil amendments as a result of a soil test, such as compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.
- An Erosion and Sediment control plan detailing full site stabilization.
- A statement regarding compliance with any permitting requirements.
- A measure to determine successful established must be specified.
- Other information as requested by the local SWCD.

- It is the applicant's responsibility to ensure that any contractors meet all local codes and responsibilities.

E. Operation and Maintenance

- Maintenance will follow guidelines on the Virginia BMP Stormwater Clearinghouse, Design Specification No. 9.
- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Annual survey of planted area to evaluate for:
    - invasive species
    - plant survival/success
    - ensure all vegetation stabilization measures remain intact
    - runoff flow routes function
  - If invasive species are present (according to: www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf), remove to reduce invasive cover ground cover to less than 5%.
  - Tree and shrub mortality will be addressed annually by replanting the species with adequate protection and support to ensure survival.
  - Reapply wood mulch as needed.
  - Trash should be removed at least annually.
- Sediment removal in the ponding and pretreatment areas may be necessary every 3 years.

F. Cost-Share Rates/Incentives

- Reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $10,000.00.

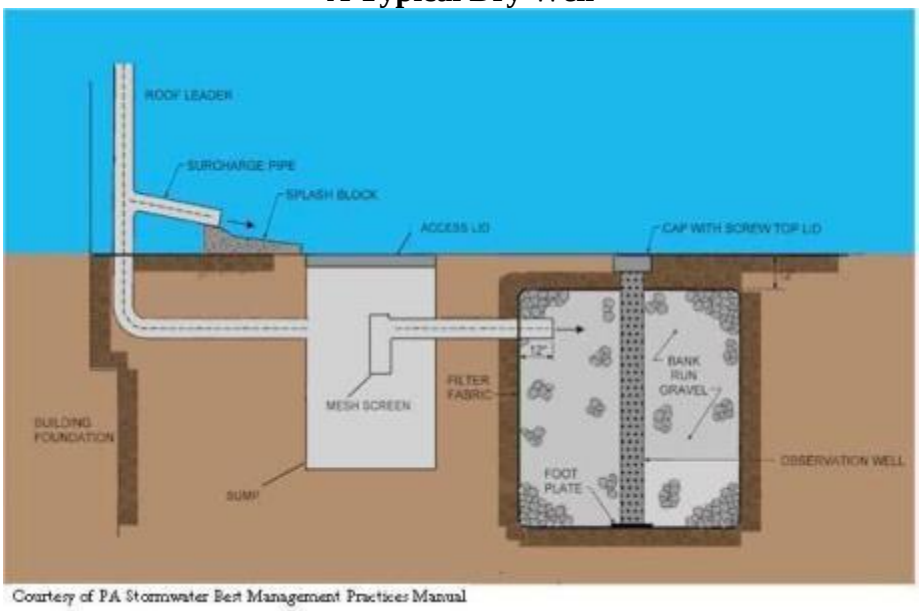
G. Helpful Technical References

- Virginia BMP Stormwater Clearinghouse, Design Specification No. 9 Bioretention http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Rain Garden Landscape Templates for the Mid-Atlantic http://www.lowimpactdevelopment.org/raingarden_design/

Section 3.6 Dry Well (DW)

A Dry Well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with gravel. Due to its storage capacity, a dry well may be used to reduce the total stormwater quality design storm runoff volume that a roof would ordinarily discharge to downstream stormwater management facilities. These practices designed to treat runoff from small areas, such as individual rooftops, driveways and other on-lot features in single-family detached residential developments. Inflow is typically from a downspout with energy dissipaters or can be sheet flow from a driveway/patio or lawn.

A Typical Dry Well



Courtesy of PA Stormwater Best Management Practices Manual

Policies Regarding DW

A. Screening Factors

- Applicable only where the subgrade soils have the required permeability.
- Depth of water table or bedrock shall be greater than 2 feet.
- Not appropriate where high pollutant or sediment loading is anticipated due to potential groundwater contamination.
- Not appropriate where there is a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of drain fields or other subsurface structures.

B. Criteria

- Project drainage areas less than 10,000 sq. ft. will not contain more than 2,500 sq. ft. of impervious surface cover. Project drainage areas over 10,000 sq. ft. will not contain more than 25% impervious cover.
- Runoff should be captured within 40 feet of downspout or impervious surface.
- The site must have soils capable of infiltrating stormwater runoff or the applicant must be willing to amend the soil. If the need for an underdrain is identified the applicant should consider an Infiltration practice.
- Should retain water for less than 48 hours after a storm event.
- Not be placed in wetland soil or within the 100-year flood plain.
- Depth of storage is typically between 1 and 5 feet, with at least 18 inches of sod cover.
- Gravel Storage shall be wrapped in non-woven geotextile
- Leaf Screens or debris sump shall be used as pretreatment to prevent clogging.
- Not intended to provide storage for large storms; therefore, a stable stormwater overflow or bypass route must be provided.
- All vegetated areas that drain to the dry well must be maintained in full vegetative cover with no scour areas.
- Sodding must occur immediately after construction. Seasonal exceptions can be made

C. Plans and Specifications

- A design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
    - Results of a percolation test (see Section 3.0 for infiltration test details)
    - A detailed plan showing dimensions, depth, square footage, and materials.
    - Total drainage area of the site, the amount of impervious surface draining to the project, and calculation to determine dry well is sized properly.

• Use the following equation derived from the static infiltration method from the Virginia BMP Clearinghouse to determine appropriate Dry Well size:

Impervious Surface (sq.ft.) x 0.95/(4.8D) = _____ sq.ft.
Pervious Surface (sq.ft.) x 0.25/(4.8D) = _____ sq.ft.
Total Dry Well Size Required = _____sq.ft.

- Slope of the land
- Installation requirements and sequencing.
- Distance to watercourses or drainage structures (along flow path).
- Existing vegetation to be kept in the new landscape.
- Soil types and any required soil amendments as a result of a soil test, such as compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.
- A plan for full site stabilization.
- A statement regarding compliance with any permitting requirements.

D. Operation and Maintenance

- Maintenance of the downspouts and pretreatment devices will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Inspection of pretreatment devices
  - Inspection of observation well for signs of standing water
  - Routine maintenance of sod to ensure vegetative cover survives.

E. Cost-Share Rates/Incentives

- Reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $2,000.00 per application.
- Incentive payments will be paid to the applicant (landowner) following approval of installation by the local SWCD.

F. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse Design Specification No. 1 Soil Amendments and No. 8 Infiltration Practices http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Section 3.7 Infiltration Basin (IB)

A Typical Infiltration Practice

Infiltration is a practice that provides temporary surface and/or subsurface storage of runoff. Examples include gravel trenches or sodded area over an underground gravel bed or storage chambers with or without an underdrain. Infiltration practices typically treat larger drainage areas such as parking lots, multiple lots and/or commercial rooftops. Inflow can be either sheet flow or concentrated flow. Infiltration should be located in common area or within drainage easements, to treat a combination of roadway and lot runoff. Infiltration used on individual residential lots is commonly referred to as a *Dry Well* and is covered in Section 3.6 above.

Infiltration may also be self-contained structures such as expanded tree pits, curb extensions, and foundation planters located in ultra-urban developed areas such as city streetscapes.

The primary component of the Infiltration practice is a high void media either gravel or reinforced storage chamber. The underdrain consists of a perforated pipe in a gravel layer installed along the bottom of the filter bed.

Infiltration practices can either be sized for Level 1 treatment (i.e. 1 inch rainfall) or an enhanced Level 2 treatment (i.e. 1.25 inch rainfall) with additional pretreatment measures.

The Virginia Stormwater BMP Clearinghouse, Stormwater Design Specification No. 8 Infiltration, should be used for planning and design details.

Policies Regarding IB

A. Screening Factors

- Applicable only where the subgrade soils have the required permeability.

- Depth of water table or bedrock shall be greater than 2 feet.
- Not appropriate where high pollutant or sediment loading is anticipated due to potential groundwater contamination.
- Not appropriate where there is a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of drain fields or other subsurface structures.
- Implementation of a Level 2 design receives a higher priority.

B. Criteria

- This BMP is intended to treat impervious surface areas greater than 2,500 square feet, and with a contributing drainage area of less than 2 acres.
- Infiltration practices will not be placed on wetland soils or in the 100 year flood plain.
- Ponded water should be retained no longer than 48 hours. Ensure that there are appropriate numbers of underdrain pipes and that are adequately sized to meet this criterion.
- Underdrains may be removed when the soil infiltration rate has been confirmed to be adequate.
- Appropriate pretreatment practices shall be provided. See appendix B.
- The designer should provide for relief from the storm event specified by local ordinance or for the 25-year storm event, whichever is the most stringent.
- A stable stormwater overflow must satisfy Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations and Virginia Stormwater Regulations.

C. Plans and Specifications

- **A licensed professional design certification and as-built certification is required.**
- A planting/design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the planting/design plan includes:
    - Site map illustration location on property
    - A detailed plan showing dimensions, depth, and square footage of the Infiltration.
    - Total drainage area of the site and the amount of impervious surface draining to the project.
    - Results of a percolation test (see Section 3.1 for infiltration test details).
    - Slope of the land.
    - Linear feet of stream being buffered (if applicable).
    - Installation requirements and sequencing.
    - Distance to watercourses or drainage structures (along flow path).

  - Existing vegetation to be kept in the new landscape.
  - Soil types and any required soil amendments as a result of a soil test, such as compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.
  - An Erosion and Sediment control plan detailing full site stabilization.
  - A statement regarding compliance with any permitting requirements.
  - A measure to determine successful established must be specified.
  - Other information as requested by the local SWCD.
- It is the applicant's responsibility to ensure that any contractors meet all local codes and responsibilities.

D. Operation and Maintenance

- Maintenance will follow guidelines on the Virginia BMP Stormwater Clearinghouse, Design Specification No. 8.
- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Trash should be removed at least annually.
- Sediment removal in the ponding and pretreatment areas may be necessary every 3 years.

E. Cost-Share Rates/Incentives

- Reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $10,000.00.

F. Helpful Technical References

- Virginia BMP Stormwater Clearinghouse, Design Specification No. 8 Infiltration Practices http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Virginia Erosion and Sediment Control Handbook http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications/ESCHandbook.aspx

Section 3.8 Rainwater Harvesting (RWH)

A Cistern Structure Employed in RWH

Rainwater harvesting systems intercept, divert, store, and release rainfall for future use. Rainwater Harvesting includes the collection and conveyance into an above- or below-ground storage tank where it can later be used or directed to on-site stormwater disposal/infiltration. Uses may include flushing of toilets and urinals inside buildings, landscape irrigation, exterior washing (e.g. car washes, building facades, sidewalks, street sweepers, fire trucks, etc.), fire suppression (sprinkler) systems, supply for chilled water cooling towers, replenishing and operation of water features and water fountains, and laundry, if approved by the local authority. Replenishing of pools may be acceptable if special measures are taken, as approved by the appropriate regulatory authority.

In many instances, rainwater harvesting can be combined with a secondary (down-gradient) runoff reduction practice to enhance runoff volume reduction rates and/or provide treatment of overflow from the rainwater harvesting system.

Policies Regarding RWH

A. Screening Factors

- Size of the water harvest area will be considered in ranking applications.
- Year round use will be prioritized.
- Local TMDL for sediment or benthic impairment existing will be considered as a priority.

B. Criteria

- This BMP is intended for retrofit applications only; not new construction.
- There is a 250 gallon minimum storage volume per application.
- The storage volume must at a minimum be sized to collect one inch of rainfall. Variances may be considered.
- Water use plans shall outline the anticipated year-round water demand. Indoor usage shall include the flow rate of each fixtures and appliances connected to the system and its

anticipated weekly use in gallons. Irrigation rates vary by crops, typically 0.67 gallons should be applied per square foot per week. See Virginia Cooperative Extension Publications or local VCE agent.

- Cisterns must be placed in accordance with manufacturing instructions. Below ground cisterns must be installed below the frost depth (typically 2 feet). Above ground cisterns must have a stable foundation slab.
- Local Building Officials and Health Department Officials should be consulted prior to installation of rainwater harvesting systems. All internal water uses and foundation designs must meet the applicable Health and Building Codes.
- Generally, winterization shall include disconnection of the downspout or following manufacturer guidelines for insulating spigots and pipes. A site-specific plan shall be included with the application. Criteria for selecting RH as a covered BMP for VCAP can be found in the Virginia BMP Stormwater Clearinghouse Design Specification No. 6 Section 6, which is incorporated into this Handbook by reference. The following sections of the Design Specification No. 6 are also applicable to the design criteria:
    - Section 2: Performance.
    - Section 4: Typical Details.
    - Section 5: Physical Feasibility & Design Applications.
    - Section 7: Regional & Special Case Design Applications.
    - Section 8: Construction.

C. Plans and Specifications

- A licensed professional engineer planting/design certification and as-built certification is required. A waiver of liability may be accepted in place of the professional certification on case-by-case basis.
- All technical design and construction details shall follow Virginia Stormwater BMP Clearinghouse Design Specification No. 6.
- A final plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the plan includes:
    - Site map illustrating location on property
    - A detailed plan showing impervious surface area of collected
    - Water use plan
    - Winterization plan
    - Cistern storage volume
    - Calculation that the storage volume is at least a minimum size to collect one inch of rainfall using the following equation:

Square footage of roof captured x 0.62 x 0.95 = **minimum gallons needed**.

*0.62 is one inch of rainfall multiplied by a conversion factor.
*0.95 is a runoff coefficient

D. Operation and Maintenance

- Maintenance of the rainwater harvesting system will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will follow guidelines of the Virginia Stormwater BMP Clearinghouse Design Specification No. 6, Section 9, including:
  - Keep gutters and downspouts free of leaves and other debris. – twice a year
  - Inspect and clean pre-screening devices and first flush diverters. – four times a year
  - Inspect and clean storage tank lids, paying special attention to vents and screens on inflow and outflow spigots. Check mosquito screens and patch holes. – annually
  - Inspect condition of overflow pipes, overflow filter path and/or secondary runoff reduction practices. –annually
  - Repair any erosion downstream of overflow outlet.

E. Cost-Share Rates/Incentives

- VCAP will pay up to $2.00 per gallon of storage volume design up to a maximum payment of $10,000.00 per applicant.

F. Helpful Technical References

- Virginia Rainwater Harvesting Manual. 2009. (http://www.rainwatermanagement.com/News/RWH_Manual2009.pdf)
- Virginia Stormwater Clearinghouse, Design Specification No. 6 (http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html)
- Thomas Jefferson Soil and Water Conservation District Rainwater Manual (http://tjswcd.org/UrbanProgram/RooftopManual.pdf)
- Virginia Stormwater BMP Clearinghouse, Cistern Design MS-Excel Spreadsheet, v. 1.6) (March 1, 2011) (http://vwrrc.vt.edu/SWC/nonproprietarybmps.html) (see Excel Spreadsheet; *Note: Long download time, in excess of 10 minutes, is possible due to file size of 215MB.*)
- Virginia Department of Health. Virginia Rainwater Harvesting & Use Guidelines. 2011. (http://www.vdh.state.va.us/EnvironmentalHealth/ONSITE/gmp/documents/2011/pdf/GMP_154.pdf)
- Virginia Cooperative Extension. Summer Lawn Management: Watering the Lawn. Pub 430-010. (http://pubs.ext.vt.edu/430/430-010/430-010_pdf.pdf)
- Virginia Cooperative Extension. Irrigating the Home Garden. Pub 426-322 (http://pubs.ext.vt.edu/426/426-322/426-322.html)

Section 3.9 Vegetated Stormwater Conveyances (VSC)

Typical Channel

Vegetated Stormwater Conveyances serve to prevent scour and erosion and provide water quality treatment while conveying stormwater. They are constructed trapezoidal channels lined with vegetation that inhibit erosion. From a water quality perspective, they are preferable to pipes because they allow more soil/water contact and more opportunity for infiltration. There are three types of vegetated conveyances: Dry Swales, Step pool conveyance, and Wet Swales.

Dry swales (DS) are shallow channels with a series of check dams that provides temporary storage to allow infiltration of the desired Treatment Volume (Tv). Dry swales use an engineered soil media as the channel bed. Unless existing soils are permeable enough to infiltrate runoff into underlying soils. In most cases, however, the runoff treated by the soil media flows into an underdrain, which conveys treated runoff back to a conveyance system further downstream. The underdrain system consists of a perforated pipe within a gravel layer on the bottom of the swale, beneath the filter media. Dry swales can be planted with turf grass, tall meadow grasses, decorative herbaceous cover, or trees.

Wet swales (WS) are shallow channels with check dams that create permanent pools that intercept groundwater and provide enhanced pollutant removal within the conveyance. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions.

Step Pool Conveyance Swale (SPCS) are defined channels that convert through attenuation pools and sand seepage filters, surface runoff to shallow groundwater. These safely convey, attenuate, and treat stormwater with a series of constructed pools and riffles with engineered soil media.

SPCS can be designed to provide energy dissipation and extreme flood control, best suited to natural ravines with slopes of 10 percent or less.

Policies Regarding VSC

A. Screening Factors

- VCAP encourages consideration first of DS, then WS.
- VCAP shall consider SPCS only after all other measures have been evaluated.
- The proposed project mediates an existing drainage problem or hotspot.
- TMDL watersheds may be given priority depending on the pollutant(s) of concern to the TMDL.

B. Criteria

- Maximum contributing drainage area should be 5 acres or less.
- Must have a water quality benefit, either repair of erosion or treatment of untreated stormwater. These BMPs are not intended to be used to modify existing drainage.
- Riprap lining and erosion and sediment control stabilization are not eligible activities.
- These practices are not intended to convey flows from an intermittent or perennial stream.
- The BMP shall not discharge directly into a natural stream channel, and must be dispersed into a stable riparian buffer or vegetated filter strip. Design must ensure a stable, adequate outfall condition will exist.

C. Design

- The VSC must provide the required treatment volume with the temporary or permanent pool areas. See appendix A for calculation procedures.
- Should be designed with enough capacity to convey runoff from the 10-year design storm event within the channel banks and be non-erosive during both the 2-year and 10-year design storm events. See appendix A for calculation procedures.
- Design must include at least 3 inches of freeboard at the top of the channel during the 10-year storm for conveyance draining a single lot. Conveyances draining more than one lot or more than 1 acre shall provide a minimum of 6 inches of freeboard above the 10-year storm elevation to the foundation of adjacent structures.
- If turf reinforcement matting is used, it should be installed according to the Manufacturer's recommendations. Manufactured products should have maximum permissible velocity specifications available.
- It must be verified that temporary and permanent channel linings are adequate for design flows. It is good practice to design conservatively by multiplying the calculated velocity by a safety factor of 1.3.
- Channels should be designed with a trapezoidal or parabolic cross section. The bottom width

of the channel shall be between 4-8 feet wide. A wider channel should incorporate benches, or a gravel diaphragm to prevent braiding and erosion.

- At least one Check Dam is required at the outfall of DS and WS. Spaced according to the slope. Compacted earthen berm check dams are preferred. Pre-fabricated check dams, such as, timber, metal or concrete may be used where slop or length limitations exist. A Grass Channel can be used as a stand along practice or as a pre-treatment to the dry swale or wet swale.
- Dry Swale:
  - The soil should be tested every 200 linear feet to measure infiltration rate to determine if an underdrain is needed. Depth to Water Table or Bedrock shall be greater than 2 feet.
  - The longitudinal slope of the channel should be less than 4%.
  - Temporary pool depth shall be no more than 9 inches
  - The side slopes should be no steeper than 3H:1V, flatter slopes are encourage where adequate space is available.
  - For other design specifications refer to the Virginia Stormwater BMP Clearinghouse Specification No. 10.
- Wet Swale:
  - The longitudinal slope of the channel should be less than 2%.
  - Permanent pool depth shall have a maximum of 6 inches.
  - Temporary ponding depth for the 10-year design storm shall not exceed 12 inches above the permanent pool elevation.
  - Work best in impermeable Hydrologic Soil Group C or D.
  - A landscaping plan is required for WS. See Constructed Wetland (CW) plant reference.
  - The side slopes should be no steeper than 4H:1V to enable wetland plant growth. Flatter slopes are encouraged where adequate space is available, to enhance pre-treatment of sheet flows entering the channel.
  - For other design specifications refer to Virginia Stormwater BMP Clearinghouse Design Specification No. 11.
- Step-pool Conveyance Swale:
  - The longitudinal slope of the channel should be less than 10%. Steeper slopes may be considered when a substantial benefit can be quantified.
  - Riffles and pools shall not be more than 10 feet long.
  - Riffles shall have a depth of less than 12 inches. Pools should have a depth of 18 inches.
  - Boulder cascade shall have an elevation drop of 5 feet or less. Three pools separated by cobble riffles shall be used below a boulder cascade.
  - The width to depth ration (W/D) shall be greater than 2.
  - For other design specifications refer Anne Arundel County, Md. Step Pool Storm Conveyance Systems Design Guidelines and Calculator.

D. Ranking and Priority

- VCAP encourages consideration first of Dry Swales, then Step Pool Conveyance, then Wet Swales.
- The proposed project mediates an obvious existing environmental problem.
- Sites that drain directly into storm sewers without any other BMP treatment should be given priority.
- Sites that drain via pipes or culverts into existing detention BMPs should be given secondary priority based on an evaluation of the existing BMP.
- Sites that sheet flow to adjacent pervious land will be given low priority based on an evaluation of adjacent pervious land.
- Soil loss rates will be considered.
- TMDL watersheds may be given priority depending on the pollutant(s) of concern to the TMDL.
- The value of educational use of the site will be considered.

E. Plans and Specifications

- A licensed professional design certification and as-built certification is required.
- A design plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. Information required in the design plan includes:
  - A VCS Job Sheet and Calculation Spreadsheet
  - A suitable erosion and sediment control plan to stabilize the flow area.
  - Total drainage area of the site and the amount of impervious surface draining to the project.
  - A detailed plan showing dimensions, depth, linear footage and square footage
  - Computations for Treatment Volume (Tv) in accordance with the applicable standards from the BMP Clearinghouse.
  - Landscape Plan including type of grasses, herbaceous or trees to be planted.
  - Other details and specifications as described in the applicable BMP Clearinghouse Standard.

F. Operation and Maintenance

- Maintenance of the planted project area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specifications No. 10 and 11, including:
  - Erosion repair and sediment removal as needed
  - Removing trash and debris as needed
  - Remove invasive species

- Replace dead, diseased plantings and reseed denuded areas.

G. Cost-Share Rates/Incentives

- Dry Swale and Step Pool Conveyance reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $5,000.00.
- Wet Swale reimbursement payments will be made for up to 75 percent of costs with a maximum payment of $3,000.00.
- When pre-treatment is required for DW and WS, the pre-treatment costs are included in the cost of the primary practice.

H. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse Design Specification No. 10 and 11

  http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Virginia Erosion and Sediment Control Handbook, 3rd Edition (Chapter 5) http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications/ESCHandbook.aspx
- Virginia Erosion and Sediment Control Regulations Minimum Standards (4VAC50-30- 40) http://register.dls.virginia.gov/details.aspx?id=3205
- Virginia Erosion and Sediment Control Handbook, 3rd Edition (Chapter 3 Specifications)
  - 3.17 Stormwater Conveyance Channel
  - 3.18 Outlet Protection
  - 3.20 Rock Check Dams
  - 3.30 Topsoiling
  - 3.31 Temporary Seeding
  - 3.32 Permanent Seeding
  - 3.33 Sodding
  - 3.36 Stabilization Matting

Section 3.10 Constructed Wetlands (CW)

Constructed Wetland Receiving a Roof Drain

A constructed wetland can temporarily store, filter, and clean runoff from driveways, roofs and lawns and thereby improve water quality. To properly function in this regard, the wetland should be designed and constructed to retain water or remain saturated for two to three weeks.

Constructed wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micro pools) and possess variable micro topography to promote dense and diverse wetland cover. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity. Constructed wetlands are the final element in the roof-to-stream runoff reduction sequence. They should only be considered for use after all other upland runoff reduction opportunities have been exhausted and there is still a remaining water quality or channel protection volume to manage.

Policies Regarding CW

A. Screening Factors

- Connected Impervious Cover given highest priority
- Poorly drained soils are preferred
- Evaluate sites with poorly drained soils extremely carefully; consult the U.S. Army Corps of Engineers to evaluate impacts to jurisdictional wetlands.
- Constructed wetlands are not recommended for sites draining into a cold water stream unless planted with trees.

B. Design

- Project drainage area will not contain more than 25% impervious cover, unless the total project drainage area is less than 10,000 sq. ft. in which case impervious area will not be greater than 2,500 sq. ft.
- Constructed wetlands must be excavated to the water table elevation to maintain a

permanent base flow. Deep pools must be 24-48 inches deep. Micro-pools must be 12 inches deep or less. High marsh must be 6 inches deep or less.

- Constructed wetlands must have at least three cells. Fifteen (15%) to Twenty-five (25%) percent of the surface area must be deep pools; fifty (50%) to seventy (70%) percent of the surface area must be high marsh; and the remaining area may be micro pools. Surface area may be calculated as follows:

Impervious Surface (sq.ft.) x $0.95/(12D_{mean})$ = _____ sq.ft.
Pervious Surface (sq.ft.) x $0.25/(12D_{mean})$ = _____ sq.ft.
Total Wetland Area Required = _____sq.ft.

- Variable width aquatic bench should be provided around any deep pools for safety. Width should be between 2 and 6 feet at a depth of 12 inches.
- A sediment forebay must be located at every concentrated inlet that receives 10 percent or more of the drainage area to provide energy dissipation and pretreatment. Forebays should be at least 15 percent of the surface area. Forebays are considered deep pools.
- The designer should provide for overland relief from the storm event specified by local authority or for the 25-year storm event, whichever is the most stringent. However, the maximum pool depth shall not exceed a foot above the high marsh during this storm event.
- Refer to Appendix E Landscaping of the BMP Clearinghouse for planting zones. A short list of plants which thrive in wetland planting zones are shown in Tables 13.3 and 13.4 of Virginia Stormwater BMP Clearinghouse Design Specification No. 13. Consult a professional horticulture specialist for additional plant choices.

C. Plans and Specifications

- A licensed professional engineer design certification and as-built certification is required.
- All technical design and construction details shall follow DCR Stormwater Design Specification No. 13.
- A final plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD. The final plan should include the design elements in Virginia Stormwater BMP Clearinghouse Design Specification No. 13.
  - Site map illustration location on property
  - A detailed plan showing dimensions, depth, and square footage.
  - Total drainage area of the site and the amount of impervious surface draining to the project.
  - Results of a percolation test (see Section 3.1 for infiltration test details).
  - Slope of the land.
  - Installation requirements and sequencing.
  - Distance to watercourses or drainage structures (along flow path).
  - Existing vegetation to be kept in the new landscape.
  - Soil types and any required soil amendments as a result of a soil test, such as

compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.

- An Erosion and Sediment control plan detailing full site stabilization.
- A statement regarding compliance with any permitting requirements.
- A measure to determine successful established must be specified.
- Other information as requested by the local SWCD.

D. Operation and Maintenance

- Maintenance of the wetland area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will follow guidelines on the DCR Stormwater Design Specification No. 13.
- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Invasive Species removal
  - Vegetation remains healthy and established
  - Check for erosion and deposition in the pools
  - Removal trash and debris as needed
- Sediment removal in the pools and forebays may be necessary every 3 to 5 years.

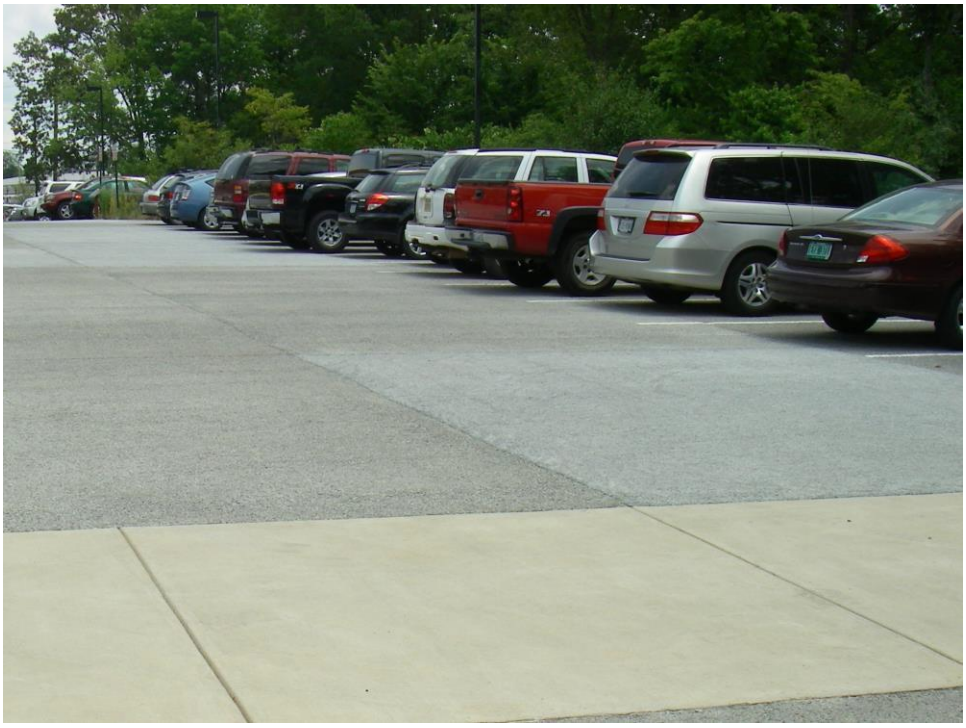
E. Cost-Share Rates/Incentives

- The VCAP will reimburse 75 percent cost-share with a maximum payment of $5,000.00.

F. Helpful Technical Resources

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 13 Constructed Wetlands, Design Specification Appendix D, Design Specification Appendix E http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Hunt, William F. and Bill Lord. 2006. Urban Waterways, Maintenance of Stormwater Wetlands and Wet Ponds. North Carolina Cooperative Extension Service. (Hunt and Lord, 2006)

Section 3.11 Permeable Pavement (PP)



Typical Porous Concrete

Typical Interlocking Concrete Pavers

Permeable pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. A variety of permeable pavement surfaces are available, including *pervious concrete, porous asphalt***,** and permeable *interlocking concrete pavers*. While the specific design may vary, all permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom.

Traditionally paved surfaces are impermeable, converting rainfall to runoff. Permeable pavement promotes a high degree of runoff volume reduction and nutrient removal, and it can also reduce the effective impervious cover of a development site. Permeable pavements may be constructed of permeable asphalt, pervious concrete, permeable interlocking concrete pavers, concrete grid pavers and grassy pavers. They are typically underlain by a gravel reservoir layer ranging in thickness from 4 to 12 inches. The thickness of the reservoir layer is determined by both a structural and hydrologic design analysis. The reservoir layer serves to retain stormwater and also supports the design traffic loads for the pavement. In low-infiltration soils, some or all of the filtered runoff is collected in an underdrain and returned to the storm drain system. If infiltration rates in the native soils permit, permeable pavement can be designed without an underdrain, to enable full infiltration of runoff. A combination of these methods can be used to infiltrate a portion of the filtered runoff.

Permeable pavement is typically designed to treat stormwater that falls on the actual pavement surface area, but it may also be used to accept run-on from small adjacent impervious areas, such as impermeable driving lanes or rooftops. However, careful sediment control is needed for any run-on areas to avoid clogging of the down-gradient permeable pavement.

Policies Regarding PP

A. Ranking and Priority

- Sites that drain directly into storm sewers without any other BMP treatment should be given high priority.
- Sites that drain via pipes or culverts into existing BMPs should be given lower priority based on an evaluation of the existing BMP.
- Sites that sheet flow to adjacent pervious land will be given lower priority based on an evaluation of adjacent pervious land.
- TMDL watersheds may be given higher priority depending on the pollutant(s) of concern to the TMDL.
- The value of educational use of the site will be considered a plus.
- Longer lifespan agreements could increase the projects priority.

B. Criteria

- The VCAP will involve projects of ½ acre or less.
- Project sites must be free from impacts of adjacent construction sites.
- The site must have soils capable of infiltrating stormwater or the applicant must be willing

to replace or amend the soil.

- PP will not be installed on wetland soils or in the 100 year flood plain.
- The impact of freeze/thaw on the project must be evaluated. A gravel or sand underbed is required.
- The applicant should be aware that some PP applications or products require substantially more on-going maintenance.
- PP should not be hydraulically connected to any structure foundations.

C. Plans and Specifications

- **A licensed professional engineer design certification and as-built certification is required.**
- All technical design and construction details shall follow Manufacturers' recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 7.
- A final plan for the site must be submitted by the landowner and approved by the local Soil and Water Conservation District before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the local SWCD.
    - Soil infiltration rate must be verified per Clearinghouse Design Specification No. 7.

D. Operation and Maintenance

- All Operation and Maintenance must follow manufacturers' recommendations.
- Maintenance of the wetland area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will follow guidelines on the DCR Stormwater Design Specification No. 7.

E. Cost-Share Rates/Incentives

- The VCAP will reimburse 50 percent cost-share up to $3.00 per square foot with a maximum payment of $12,000.00.

F. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 7 Permeable Pavement http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Alliance for the Chesapeake Bay http://stormwater.allianceforthebay.org/take-action/structural-bmps/pervious-pavers/
- Manufacturers' Manuals.

Section 3.12 Green Roofs (GR)

Typical Green Roof Installation

Green Roofs or vegetated roofs are alternative roof surfaces that typically consist of waterproofing and drainage materials and an engineered growing media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growing media. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

This standard is intended for situations where the primary design objective of the vegetated roof is stormwater management. Green roof installations provide many other environmental benefits such as energy efficiency, air quality improvements, and habitat. There are two different types of vegetated roof systems: *intensive* vegetated roofs and *extensive* vegetated roofs. Intensive systems have a deeper growing media layer that ranges from 6 inches to 4 feet thick, which is planted with a wider variety of plants, including trees. By contrast, extensive systems typically have much shallower growing media (2 to 6 inches), which is planted with carefully selected drought tolerant vegetation. This standard was developed for the installation of extensive green roof systems. Intensive systems are eligible to apply but the incentive payment rate remains the same. Please refer to Virginia Stormwater BMP Clearinghouse Design Specification No. 5 Vegetated Roof for details of each type.

Policies Regarding GR

A. Ranking and Priority

- Public visibility and the potential to serve as an educational site.
- Sites with the ability to employ other stormwater management features that are less expensive shall be ranked lower.
- Flat roofs get a higher ranking due to their ability to more effectively treat stormwater.
- Preference will be given to landowners who have not previously received incentive

payments from the District for this BMP.

B. Criteria

- Sites must be 200 square feet or larger.
- Plant establishment may be plugs/container; cuttings; seeding; vegetated mats; or modular/tray systems. Native species or mixes that are adapted to the site conditions and intended uses are encouraged to be used. Selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame. Establishment of vegetation generally takes 1-2 years. Invasive or noxious species, as identified by DCR invasive species list (http://www.dcr.virginia.gov/natural_heritage/invspinfo.shtml), are prohibited.
- Species, density/rate of seeding or planting, minimum quality of planting stock and method of establishment shall be specified as part of the application. Only viable, high- quality seed or planting stock that is shallow-rooted, self-sustaining, and tolerant of direct sunlight, drought, wind, and frost should be used. Seeding or planting must be done at a time and in a manner that best ensures survival and growth of the selected species. The planting window extends from the spring to early fall, allowing plants to root thoroughly before the first killing frost. Green roofs should not be planted in the winter. Temporary irrigation is often necessary during dry months as the roof is established.
- North and east aspects are preferred for survivability of vegetation and reduction of irrigation.

C. Design

- Green roof designs shall include the following components:
  - deck layer with adequate structural support
  - waterproofing layer
  - insulation layer
  - root barrier
  - drainage layer and system
  - root permeable filter fabric
  - growing media
  - plant cover – shallow-rooted, perennial, succulent plants are ideal
- Roof pitch shall be a minimum of ¼": 12" (2%) and no more than 2":12" (16%).
- Longest flow path shall be less than 75 feet.
- Drainage layer shall be a minimum of 2 inches of pea gravel or a mat system.
- Growing media shall have less than 15% organic matter. Compost amendments must be free of detectable levels of pesticides and other hazardous chemicals.
- The applicant is responsible for ensuring that the proposed installation and maintenance plan meets all applicable local policies and ordinances.
- Site constraints for construction and design should be identified (HVAC, Electrical, Roofing materials, Pitch/Slope, Access and Process for getting materials on the roof).

- Green roof installation can be used in concert with other stormwater management practices, such as rain gardens, wet/dry swales, and rain water harvesting.
- Green roof loadings should be less than 30 pounds per square foot.

D. Plans and Specifications

- A licensed professional engineer design certification and as-built certification is required.
- All technical design and construction details shall follow Manufacturers' recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 5.
- A design and installation plan for the green roof must be submitted by the property owner, with an engineer's stamp, and approval by the local Building Office before funding is approved. The installed practice must be in accordance with the approved design unless changes were pre- approved by the local SWCD. What constitutes successful installation and planting establishment must be specified in the design plan. Information required in the plan includes:
  - Square footage of green roof including dimensions with roof slope/pitch
  - Stormwater Treatment Volume and Pollutant Removal
  - waterproofing specifications
  - structural design specifications
  - nonwoven geotextile fabric specifications
  - proposed growing medium depth and composition
  - proposed vegetation and seeding/planting rate
  - drainage system specifications
  - drainage and overflow system details
  - maintenance plan
  - irrigation considerations (permanent or temporary watering systems, hose bib connections, etc.)
  - other information as requested by the local SWCD

E. Operation and Maintenance

- Maintenance of the planted area will be conducted a minimum of twice annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Irrigation during the establishment period or as determined by the planting plan
  - Invasive Removal
  - Replace dead, dying and diseased plants. Ensure no bare spots are present
  - Checking drainage systems to ensure no clogs, obstructions, or other damage impacting proper drainage flow
  - Assessing structural systems to ensure no damage
  - Assessing for leaks, soil erosion, and other functional issues

I. Cost Share Rates/Incentives

- This BMP will offer incentive payments based on area planted. It is an incentive payment rate of $10 per square foot, up to a maximum of $10,000.00 per applicant.
- Incentive payments will be paid to the applicant (landowner) following approval of installation by the local SWCD.

J. Helpful Technical References:

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 5 Vegetated Roof http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html
- Dunnett, N. and N. Kingsbury. 2004. *Planting Green Roofs and Living Walls*. Timber Press. Portland, Oregon.
- Weiler, S. and K. Scholz-Barth 2009. *Green Roof Systems: A Guide to the Planning, Design, and Construction of Landscapes over Structure.* Wiley Press. New York, NY. http://www.pomegranate.org/wp-content/publications/Pomegrante-Center-Greenroof-Manual- 2005.pdf
- http://www.greenroofs.com/Greenroofs101/index.html
  http://www.portlandoregon.gov/bes/article/331490
  http://www.portlandoregon.gov/bes/article/259381
  http://www.wbdg.org/resources/greenroofs.php
  http://agronomy.unl.edu/c/document_library/get_file?uuid=1f1f203c-034c-4f42-b7d6-0ca4300b0225&groupId=4128273&.pdf
- Modular Roof: http://www.thisoldhouse.com/toh/how-to/step/0,,20473692,00.html
- The Green Roof Manual: A Professional Guide to Design, Installation, and Maintenance. By Edmund C. Snodgrass and Linda McIntyre
- http://stormwater.allianceforthebay.org/take-action/structural-bmps/green-roofs/

National Standards

ASTM International. *Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems. Standard E2399-05*www.astm.org/Standards/E2399.htm

ASTM International. *Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Vegetative (Green) Roof Systems. Standard E2396-05*www.astm.org/Standards/E2399.htm

ASTM International. *Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems. Standard E2398-05*www.astm.org/Standards/E2398.htm

ASTM International. *Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems. Standard E2397-05*www.astm.org/Standards/E2397.htm

ASTM International. *Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems. Standard E2400-06*www.astm.org/Standards/E2400.htm

Section 3.13 Urban Nutrient Management Planning (UNMP)

Surveys[1] show that about 50 percent of homeowners fertilize their lawns, but fewer than 20 percent of those who fertilize consult an expert lawn professional or take a soil test to determine the optimal fertilization strategy. Nutrient export associated with turf grass fertilizer use from home, commercial and industrial lawns depends on various landscape factors, fertilizer application rates and overall lawn care practices. Having an urban nutrient management plan developed ensures an optimal fertilization strategy will be implemented and helps to reduce nutrient export from fertilized lawns.

[1]Schueler, T., Lane, C. 2013. Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management: CBP Approved Final Report. p34-35.

Policies Regarding UNMP

Urban Nutrient Management plans (UNMP) have relatively few practice constraints other than: the area associated with the plan must currently be fertilized or have a critical need to be renovated because of poor or no vegetative cover, the property owner agrees to keep fertilization records regardless of who is making the applications, the property owner agrees to have a certified fertilizer applicator apply all fertilizer in accordance with the plan or the property owner demonstrates they have the necessary knowledge along with proper application and calibration equipment to apply the fertilizer themselves.

Definitions:
An **amended** Urban Nutrient Management Plan is a current UNMP that has been updated to accurately match current landscape management practices. Plans only need to be amended if changing of landscape plants or turfgrass species drastically alters the optimal fertilization strategy outlined in the current plan.

A **revised** Urban Nutrient Management Plan is an expired UNMP that has been rewritten to accurately match actual landscape plants and/or lawn management practices.

A. Ranking and Priority (high and low)

- Proximity to stream, river, storm drain, or bay (within 300 feet = high priority)
- Very High (VH) Virginia Tech soil test phosphorus fertility rating or correlated to VH from another lab
- Area was previously over fertilized compared to DCR guidelines
- Newly established turf
- Fertilized areas have slopes greater than 15% (and account for 33% or more of the landscape)
- High water table
- Soil types: shallow soils , sandy soils or karst terrain
- Educational opportunities

B. Criteria

- This BMP applies to fertilized turf grass landscapes and other ornamental plant landscape areas that receive nutrients at least once in a three year period.
- In order to be eligible for cost-share, urban nutrient management plans must be prepared by a private planner who holds a current Nutrient Management Planner Certificate in the Turf and Landscape Category issued by the Virginia Department of Conservation and Recreation. Urban Nutrient Management Plans must be written to comply with all requirements set forth in the Nutrient Management Training and Certification Regulations, (4 VAC 50-85-10 et seq.) and the criteria set forth in the Virginia Nutrient Management Standards and Criteria, revised July 2014.
- Plans must be developed based on soil analyses taken within a three year period prior to plan development and must be performed by soil testing laboratories approved by DCR.
- Before cost-share payment can be made the following items must be submitted:
    - A complete copy of the nutrient management plan, containing the planner's Virginia Nutrient Management Certificate number.
    - An invoice for planning services from the private certified planner.
    - If applicant is seeking cost-share for a plan previously written under this specification, fertilizer application records and the previous plan must be presented to SWCD staff for review.

C. Plans and Specifications

- Urban Nutrient Management Plans will be prepared to include all necessary information as outlined in the Nutrient Management Regulations 4 VAC 50-85-10 et seq. Outlined plan content can be found at: http://www.dcr.virginia.gov/soil_and_water/documents/nmtmsc-tl_plan_checklist.pdf

D. Operations and Maintenance

- Applicant is required to keep all fertilizer records regardless of who makes the applications.
- Applicant is responsible for notifying the certified planner when landscape plants or lawn care practices have changed, warranting amendment of the plan.
- Applicant is responsible for maintaining adequate vegetative cover.
- All plans are subject to spot check procedures and any other quality control measures.

E. Cost-Share Rates

- Reimbursement will be up to $100 per applicant. If the plan is written through a Virginia Cooperative Extension Master Gardener program the maximum allowable reimbursement is equal to the fee associated with the Master Gardener Program.
- Participants may redirect their cost-share payment to their private certified nutrient management planner by signing a written statement to that effect. A sample statement is attached to this specification

F. Helpful Technical References

- Chapter 13 of the Urban Nutrient Management Handbook
- Nutrient Management Standards and Criteria Revised July 2014
- Fertilizer Applicator Certification Training (FACT)
- Fertilizer calculator (Derek)

ASSIGNMENT OF URBAN NUTRIENT MANAGEMENT PLAN WRITING COST-SHARE PAYMENT AUTHORIZATION

I _____, do hereby direct
Name

the _____Soil and Water Conservation District (SWCD) to pay any and all cost-share funds disbursed under the URBAN NUTRIENT MANAGEMENT PLAN WRITING to

_____, of
Name

_____ for
Business

services provided during development of my Nutrient Management Plan.

_____
Signature

_____
Date

General References

(CBPWQGIT, 2010) Chesapeake Bay Program Water Quality Goal Implementation Team, 2010. Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model. Accessed at: http://www.chesapeakebay.net/documents/merged_NutrientSediment_Control_Review_Protocol.pdf.

(DCR, 2012) Virginia Department of Conservation and Recreation. 2012. Stormwater Management. Accessed at: http://www.dcr.virginia.gov/stormwater_management/ripbuff.shtml.

(DCR, 2012a) Commonwealth of Virginia Department of Conservation and Recreation. 2012. Commonwealth of Virginia Chesapeake Bay TMDL Phase II Watershed Implementation Plan, March 30, 2012. Accessed at: http://www.dcr.virginia.gov/vabaytmdl/documents/baytmdlp2wip.pdf.

(DCR, 2012b) Commonwealth of Virginia Department of Conservation and Recreation. 2012. DCR's Data Exchange Template for the NEIEN Submission of NPS BMPs, February 15, 2012.

(DCR, 2011) Virginia Department of Conservation and Recreation. 2011. Virginia DCR Stormwater Design Specification No. 7, Permeable Pavement, Version 1.8
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(Ferguson, 2005) Ferguson, B.K., editor. 2005. Porous Pavements. Boca Raton, FL, CRC Press LLC.

(Leopold, 1968) Leopold, L.B. 1968. Hydrology for Urban Land Planning. U.S. Geological Survey Circular 544.

(Potomac Conservancy, 2008) Potomac Conservancy. 2008. State of the Nation's River, Potomac Stormwater Runoff. Accessed at: http://www.potomac.org/site/wp-content/uploads/pdfs/pc_sonr_web.512kb.pdf.

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(Schueler, 1987) Schueler, T. 1987. Controlling Urban Runoff – A practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, DC 240 pp.

(Smith, 2000) Smith, D.R. 2000. Permeable Interlocking Concrete Pavements: Selection, Construction, Maintenance, second edition. Washington, DC, Interlocking Concrete Pavement Institute.

(Smith, 2006) Smith, David R. 2006. Permeable Interlocking Concrete Pavement-Selection Design, Construction and Maintenance. Third Edition. Interlocking Concrete Pavement Institute. Herndon, VA.

(UVA, 2012) UVA Today. 2012. U.Va. Researchers: Virginia's Growth Outpaces Nation's. Accessed at: http://www.virginia.edu/uvatoday/newsRelease.php?id=17201.

(USEPA, 2010) United States Environmental Protection Agency Chesapeake Bay Program. 2010. Chesapeake Bay Phase 5 Community Watershed Model. Section 6. Best Management Practices for Nutrients and Sediments. Accessed at: ftp://ftp.chesapeakebay.net/modeling/P5Documentation/SECTION_6.pdf.

(Vepraskas, 1999) Vepraskas, M.J. 1999. Redoximorphic Features for Identifying Aquic Conditions. Tech. Bull. 301. NC Agric. Exp. Stn., Raleigh, NC.

(VWRRC, 2011) Virginia Water Resources Research Center. 2011. Virginia DCR Stormwater Design Specification No. 9, Bioretention, accessed at: http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/VASWMBMPSpec9BIORETENTION.html.

Appendix A – Calculations Specific to VCAP BMPs

A.1 **Determining Pollutant Load**

The state of Virginia has accepted the Simple Method procedure for determining pollutant loads from developed sites. A more detailed discussion and derivation of the Simple Method can be found in *Appendix A* of *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, published by the Metropolitan Washington Council of Governments. The Simple Method uses impervious cover as the key variable in calculating the levels of pollutant transported. The Simple Method is an easy technique that is used to calculate the Treatment Volume for a given stormwater treatment practice. The technique requires a modest amount of information including: (1) area that will be draining to the proposed BMP location in acres, (2) the percentage of the drainage area that is impervious, (3) annual regional rainfall, and (4) pollutant concentration.

Simple Method General Pollutant Load Equation for chemical constituents:

$L = 0.226 \times R \times C \times A$

L = relative total pollutant load (lbs/year)
R = Annual Runoff (inches)
C = Pollutant Concentration (see table A1)
A = drainage area treated by stormwater treatment practice (acres)

Note: 0.226 is a conversion factor

Simple Method General Pollutant Load Equation for Bacteria:

$L = 103 \times R \times C \times A$

L = relative annual load of bacteria (billions of colonies)
R = Annual Runoff (inches)
C = Pollutant Concentration (see table A1)
A = drainage area treated by stormwater treatment practice (acres)

Note: 103 is a conversion factor

Calculate Annual Runoff

$R = P \times P_j \times Rv$

P = average annual rainfall (inches), usually 43 inches*
P_j = unit less correction factor for storms with no runoff = 0.9
Rv = unit less Runoff coefficient

Note: * indicates the annual rainfall may vary across the state of Virginia based on locally collected rainfall data.

Calculate Runoff Coefficient

$$Rv = 0.05 + (0.009 * I)$$

Rv = Runoff Coefficient (fraction of rainfall that will produce runoff)
I = Connected impervious percentage in watershed (%)

Table A1: National Median Concentrations for Chemical Constituents in Stormwater

Constituent	Units	Urban Runoff
TSS	mg / l	54.5[1]
TP	mg / l	0.26[1]
TN	mg / l	2.00[1]
Cu	ug / l	11.1[1]
Pb	ug / l	50.7[1]
Zn	ug / l	129[1]
E. Coli	1,000 col / ml	1.5[2]

Source: [1]Pooled NURP/USGS (Smullen and Cave, 1998), [2] Schueler (1999)

Pollutant Load Removed by Stormwater BMP

$L_{removed} = L \times EFF$

$L_{removed}$ = relative pollutant load removed from stormwater (lbs/year)
L = pollutant load treated by stormwater BMP
EFF = pollutant removal efficiency of stormwater BMP

Treatment Volume is used to meet the performance criteria for selected types of stormwater BMPs such as runoff reduction and pollutant removal practices. These stormwater BMPs must have adequate treatment volume for the removal of pollutant loads as defined by the Virginia BMP clearinghouse.

Calculate Treatment Volume

$$Tv = Rv * A * (P/12)$$

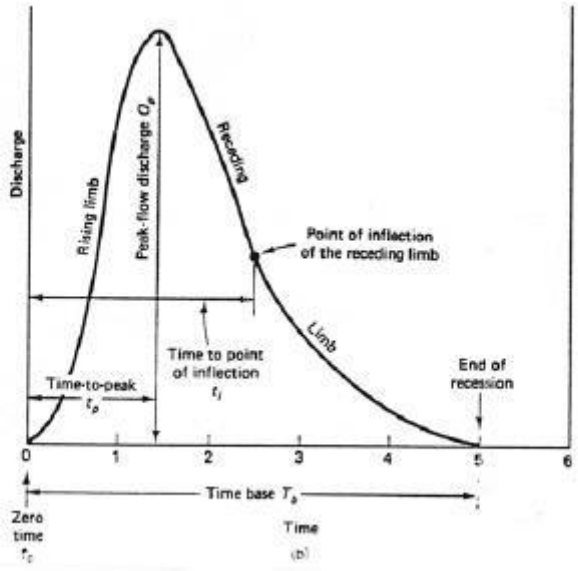
Where:

Rv = Runoff Coefficient (fraction of rainfall that will produce runoff)
Tv = Volume of runoff (ft_3)
A = Area that drains to BMP (ft_2)
P = Depth of rainfall treated (determined by the level of design for the stormwater BMP) (inches)

A.2 **Determining Peak Flow**

Determining the peak flow leaving a watershed during a storm is important when designing many stormwater BMPs. The peak flow is simply the largest flow that leaves the watershed through the course of a storm event. Figure A.1 shows a sample flow versus time relationship and its associated peak flow. The depth of rain that falls throughout the event can be observed on the right side of the graph.

Figure A.1 Runoff Hydrograph



Source: Figure 4-7 Virginia Stormwater Handbook Volume 2, 1st edition

The peak flow is used to determine the proper size of stormwater conveyance systems such as inlets, culvert and open channels and is also used to determine the proper size of outlet devices. Peak flow can be calculated easily using the "Rational Method" (Bedient and Huber, 1992) for small impervious drainage areas. Larger drainage areas with a variety of vegetative cover and soil types should use the NRCS curve number method. For details on the Curve Number method see section 4 - 4.3 of the Virginia Stormwater Management Handbook Volume 2 first edition 1999.

Rational Method:

The rational method is a simple model used to estimate the peak flow from a given watershed using a simple formula. For applications such as backyard stormwater BMPs, where small, highly impervious watersheds will be treated, the rational method offers a somewhat coarse, but adequate, estimate of peak flow. The rational formula estimates the peak rate of runoff at any location in a drainage area as a function of the runoff coefficient, rainfall intensity and drainage area. Runoff coefficient, C, represents the condition of the land within the drainage area and is based on land use, soil type and slope (See Table A.2). Rainfall intensity, I, is the average rainfall rate (inches per hour) for a storm duration equal to the time of concentration (Tc) for a selected design storm event (2-year, 10-year, etc.). The drainage area, A, is the contributing area that is being treated by the BMP.

The rational method formula is as follows:

$$Q = C\ I\ A$$

Where:

Q = Peak flow (ft^3/s)

C = Runoff Coefficient (dimensionless) see Virginia Stormwater Management Handbook

A = Watershed area being treated (in acres)
I = Rainfall Intensity of storm event (in inches/hour) see County IDF curve
(Note: There are 43,560 ft^2 in 1 acre)

Assumptions:

- Under steady rainfall intensity, the maximum discharge will occur at the watershed outlet at the time when the entire area above the outlet is contributing runoff.
- The time of concentration is equal to the minimum duration of peak rainfall.
- The frequency or return period of the computed peak discharge is the same as the frequency or return period of rainfall intensity (design storm) for the given time of concentration.
- The fraction of rainfall that becomes runoff is independent of rainfall intensity or volume.
- The peak rate of runoff is sufficient information for the design of stormwater detention and retention facilities.

Limitations of Rational Method:

- The given watershed has a time of concentration, t_c, less than 20 minutes;
- The drainage area is less than 20 acres.

A.3 **Outlet Sizing**

Sizing Underdrains:

1. Determine drawdown rate
   Use Darcy's Equation: $Q = 2.3e^{-5} K (SA) (H/L)$

   Where Q = drawdown rate (cfs)
   K = hydraulic conductivity of media (in./hr.)
   SA = surface area of media (sq. ft.)
   H = height of water above the underdrain (ft.) (typ. treatment volume elevation)
   L = thickness of media (ft.)

2. Size the underdrain pipe to carry 10x drawdown rate

   $Q' = 10 (Q)$ Where Q' is design flow rate and Q is drawdown rate.

3. Calculate pipe capacity (N x D)
   $N \times D = 16 (Q' n / S^{0.5})^{3/8}$

   Where N = number of pipes
   D = Diameter of pipe (inches) Q' = design flow rate (cfs)
   n = Manning Roughness Coefficient (see table A3)
   S = pipe slope (Typ. Assumed 0.5%)

Table A3 Manning Roughness Coefficients for Underdrain Pipes

Pipe Material and Diameter	Manning Roughness Coefficient
4 inch Corrugated Plastic (Typ. HDPE)	0.014 – 0.015
4 inch Smooth Plastic (Typ. PVC)	0.010 – 0.011
6 inch Corrugated Plastic (Type. HDPE)	0.014 – 0.015
6 inch Smooth Plastic (Typ. PVC)	0.010 – 0.011
8 inch Corrugated Plastic (Typ. HDPE)	0.015 – 0.016

4. Find the number of underdrain pipes and diameter size combination (N x D) that will carry the flow rate.

Installation Note:

- Install underdrains in a gravel bed at least 2 inches over the top of the pipes. The minimum gravel thickness is determined by the diameter of the pipe.
- Install outlet protection where underdrain daylights.
- Discharge underdrain to adequate outfall.

Principal Outlet Orifice:

Particular BMPs may have a hydraulic depth (i.e. head) of ponding sufficient to allow a pipe outlet. These BMPs will be designing a barrel outlet based on the orifice equation.

$Q = C\ a\ \sqrt{(2gh)}$
Where Q = design flow rate (cfs)
C = orifice coefficient (typ. 0.6) a
= area of orifice (sq. ft.)
g = gravitational acceleration, 32.2 ft/ sec^2 h
= head or depth of dry storage (ft.)

To size the barrel orifice, rearrange the equation and solve the area of orifice. Then use the following equation: $d = \sqrt{(4\ a\ /\ \prod)}$

Overflow Weirs:

Weir outlets should be sized so that the berm is not overtopped during a 10-year storm event. This means that the weir notch must be long enough to allow the peak flow associated with the 10-year storm to pass without the water rising high enough that the top of the berm is reached. To determine the appropriate length of weir notch to pass the 10-year storm, the weir equation can be applied.

Determining the Weir Notch Length:

$$Q = C_w\ L\ H_{1.5}$$

Where:

Q = Flow (ft^3/s) – Use peak flow from 10-year event

C_w = Weir Coefficient (dimensionless)
L = Length of Weir (in feet)
H = Height of Water Over Top of Weir (in feet) – Use 0.5 feet

The peak flow rate passed by the weir is the flow associated with the 10-year event (see appendix A2). The weir coefficient is set to 2.7 and the 10-year depth over the top of the weir should be no higher than 2 inches (0.17 feet) so the water will not flow over the containment berm. Thus, the only unknown in the equation is the length of the weir. This equation can be rearranged to solve for the weir length.

Determining the Weir Length:

$$L = Q \div (C_w H_{1.5})$$

Weir Installation Note:

- All rigid weir structures should be tied into the underlying soils.
- Soils filled around structures should be compacted and protected.
- Vegetated weirs should have sod or stabilization matting installed immediately.

A.4 **Drawdown Time**

Infiltration practices need to be able to maintain a drawdown time that will reduce ponding to less than 48 hours. The drawdown time is determined by using the Treatment Volume (App. A.1), Surface Area, Soil Porosity, and Drawdown Rate (App. A.3).

There is a two part process. When 1-inch of water is drawn out of the ponding area, when the area is inundated, the water elevation lowers roughly 1-inch. This rate (1 inch out, water level 1 inch down) will continue until the ponding area is saturated to the surface. Once the water elevation is at the surface of the ponding area, every inch of water that exits the bottom will lower the water table by more than 1 inch. This is due to soil porosity. Therefore, you must calculate the time it takes to draw the water from (1) inundation to saturation and then (2) from surface saturation to water table or underdrain at the bottom of the soil media.

A. Time to draw water from inundation to saturation at surface
    a. Find Treatment Volume (Tv)
       Use Appendix A1.

    b. Calculate Drawdown Rate
       Use Appendix A3.

    c. $T_{s\text{-}1}$, Divide Tv. By the Drawdown Rate

B. Time to draw water from saturation at surface to water table
    a. Choose Soil Porosity
       Varies from 0.2 to 0.4 depending on materials

b. Calculate Volume of Water in the Soil V = Depth (Surface Area) (porosity)

c. T_{s-2}, Divide Volume by Drawdown Rate

C. Total Drawdown Time

Time = $T_{s-1} + T_{s-2}$

A.5 Manning Equation

$V = 1.49 / n\ S^{1/2}\ R^{2/3}$

Where: V = Velocity, ft./sec
n = Mannings Roughness Coefficient
S = Slope, ft./ft.
R, Hydraulic Radius (ft.) = CSA / P_w
CSA = Cross Section Area, sq. ft.
P_w = wetted perimeter of channel, ft.

Q = V (CSA)

Where: Q = Flow Rate, cfs
V = Velocity, ft. /sec.
CSA = Cross Section Area, sq. ft.

Table A5.1: Manning Roughness Coefficient for Sheet Flow

Surface Description	'n' Value
Smooth Surfaces (Concrete, Asphalt, Gravel, or Bare Soil	0.011
Fallow (No Residue)	0.05
Cultivated Soils:	
Residue Cover < 20%	0.06
Residue Cover > 20%	0.17
Grass:	
Short Grass Prairie	0.15
Dense Grasses[2]	0.24
Bermuda grass	0.41
Range (Natural)	0.13
Woods:[3]	
Light Underbrush	0.40
Dense Underbrush	0.80

[1] The 'n' values are composite of information compiled by Engman (1986).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

(Source: 210-VI-TR-55, Second Edition, June 1986)

Table A5.2: Manning Roughness Coefficient for Channel Flow

Lining Material	'n' Value Range	
	From	To
Concrete Lined	0.012	0.016
Cement Rubble	0.017	0.025
Earth, Straight and Uniform	0.017	0.022
Rock Cuts, Smooth and Uniform	0.025	0.033
Rock Cuts, Jagged and Irregular	0.035	0.045
Winding, Sluggish Canals	0.022	0.027
Dredged Earth Channels	0.025	0.030
Canals with Rough Stony Beds, Weeds on Earth Banks	0.025	0.035
Earth Bottom, Rubble Sides	0.028	0.033
Small Grass Channels:		
Long Grass - 13"	0.042	
Short Grass - 3"	0.034	

(Source: Adapted from *Handbook of Hydraulics*, sixth edition, Brater & King)

Appendix B – Pretreatment Requirements for VCAP BMPs

General Guidance:
Pretreatment is a necessary component of many stormwater BMPs. Pretreatment is the process to reduce pollution in stormwater before the introduction into s stormwater BMP for reduction of pollutant loads. Pretreatment is usually performed to reduce constituents, such as sediment, that may interfere or substantially reduce the effectiveness of a stormwater BMP. If a particular stormwater BMP is sensitive to heavy loadings of fine sediments; or if there is a "hotspot" site which will produce high sediment and pollutant loads, then pretreatment is required.

Table B.1: Acceptable Pretreatment Measures

Sheet Flow	Concentrated Flow	Inlets
Gravel Diaphragm	Gravel Diaphragm	Leaf Screens
Grass Filter Strips	Grass Channel	Sump Basins
Other Proprietary Systems	Engineered Level Spreader	Vortex Filters
	Sediment Forebay	Other Proprietary Systems
	Other Proprietary Systems	

Specific Pretreatment Requirements:

1. For stormwater BMPs requiring pretreatment, the selected pretreatment measures must be provided above and outside of the treatment volume (Tv) area.

2. Pet Waste Stations (PWS), Turf Conversion to Natives (TCN) and Impervious Surface Removal (ISR) require no pretreatment.

3. Rain Gardens (RG), Bioretention (BR), Constructed Wetlands (CW), and Vegetated Stormwater Conveyances (VSC) require one or more pretreatment measures per the Virginia BMP Clearinghouse.
    a. Rain Garden (RG) and Bioretention (BR) are sensitive to sediment and debris and must have structural measures that minimize their delivery from both overland sheet flow and concentrated flow.
    b. Constructed Wetlands (CW) and Vegetated Stormwater Conveyance (VSC) are sensitive to erosion and re-suspension of sediments; therefore, require pretreatment that minimizes velocities of concentrated flow.

4. Rainwater Harvesting (RH) and Permeable Pavement (PP) require one or more unique pretreatment devices per the Virginia BMP Clearinghouse and Manufacturer's specifications.
    a. Rainwater Harvesting (RH) is sensitive to roof debris and must have pretreatment of the gutter and downspout system that filters, captures or divert the "first flush" volume.
    b. Permeable Pavement (PP) is sensitive to debris from pervious surfaces and application of snow removal material; therefore, pretreatment must provide filtering or change maintenance practices.

The following technical guidance for pretreatment measures can also be found in the Virginia Stormwater Management Handbook 2001 and Virginia BMP Clearinghouse.

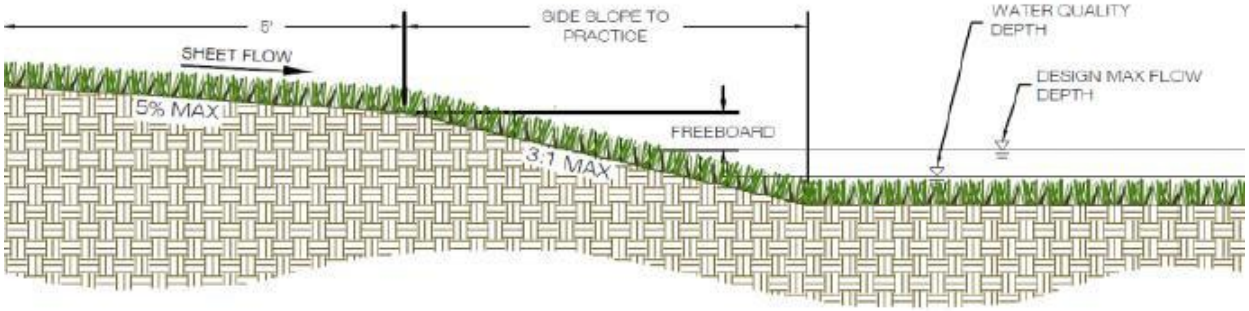
Grass Filter

When runoff is sheet flow from such areas as parking lots, residential yards, etc., is involved, a grass filter strip, often enhanced with a gravel diaphragm, is usually employed. Table B.2 provides sizing guidelines as a function of inflow approach length, land use, and slope.

- The first 10 feet of the filter strip must be 2% or less.
- The minimum filter strip length should be 10 feet.
- The contributing drainage area should not have more than 5,000 square feet of impervious surface.
- Use a gravel diaphragm when impervious surface exceeds this limit or when the minimum filter length cannot be met.

Table B.2: Pretreatment Filter Strip Sizing Guidance (Source: Claytor and Schueler, 1996)

Parameter	Impervious Parking Lot*				Residential Lawns				Notes
Maximum Inflow Approach Length (Feet)	35		75		75		150		
Filter Strip Slope	< 2 %	>2%	<2%	>2%	<2%	>2%	<2%	>2%	Max = 6%
Minimum Length	10 ft	15 ft	20 ft	25 ft	10 ft	12 ft	15 ft	18 ft	*GD as necessary



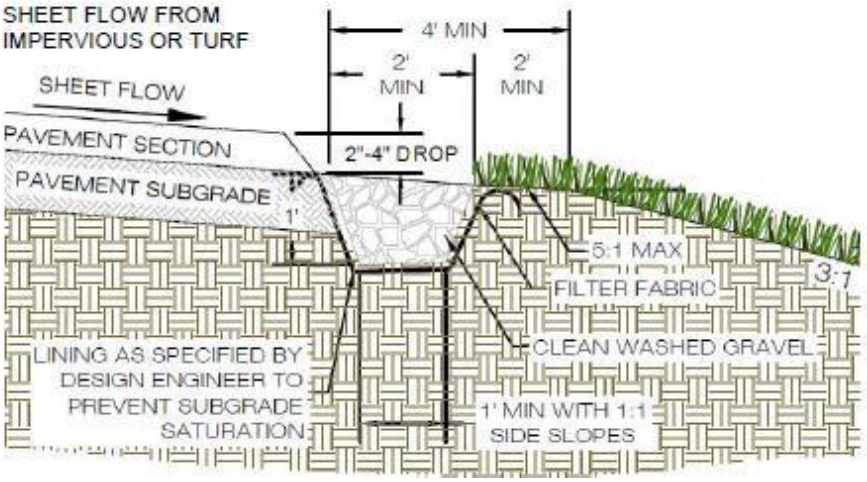
Grass Filter for Sheet Flow Pretreatment
(Va. DCR Stormwater Design Specification No. 9: Bioretention)

Gravel Diaphragm

A gravel diaphragm at the top of the slope is created by excavating a 2-foot wide and 1-foot deep trench that runs on the same contour at the top of the filter strip or grass channel. The diaphragm serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the practice. Second, it acts as a level spreader, maintaining sheet flow.

- The flow should travel over the impervious area and to the practice as sheet flow and then drop at least 3 inches onto the gravel diaphragm. The drop helps to prevent runoff from running laterally along the pavement edge, where grit and debris tend to build up.
- A layer of nonwoven filter fabric should be placed between the gravel and the underlying soil trench.

- If the contributing drainage area is steep (4% slope or greater), then larger stone (clean gravel that meets VDOT #57 grade) should be used in the diaphragm.
- If the contributing drainage area is solely turf (e.g., lawn), then the gravel diaphragm may be eliminated.



Gravel Diaphragm – Sheet flow Pretreatment
(Va. DCR Stormwater Design Specification No. 2: Sheet flow to Filter or Open Space)

Grass Channel

For applications where concentrated runoff enters the practice by surface flow, such as through a slotted curb opening, a grassed channel, often equipped with a gravel diaphragm to slow the velocity and spread out the flow entering the basin, is the usual pretreatment method. The length of the grassed channel depends on the drainage area, land use, and channel slope. Table B.3 provides recommendations on sizing for grass channels leading into a practice for a one acre drainage area.

- The minimum grassed channel length should be 20 feet.
- Use a gravel diaphragm when the minimum length cannot be met.
- For detailed design as a cost-shared BMP see Vegetated Stormwater Conveyances (VSC) Standard 2.12.

Table B.3: Pretreatment Grass Channel Sizing Guidance for a 1.0 Acre Drainage Area (Source: Claytor and Schueler, 1996)

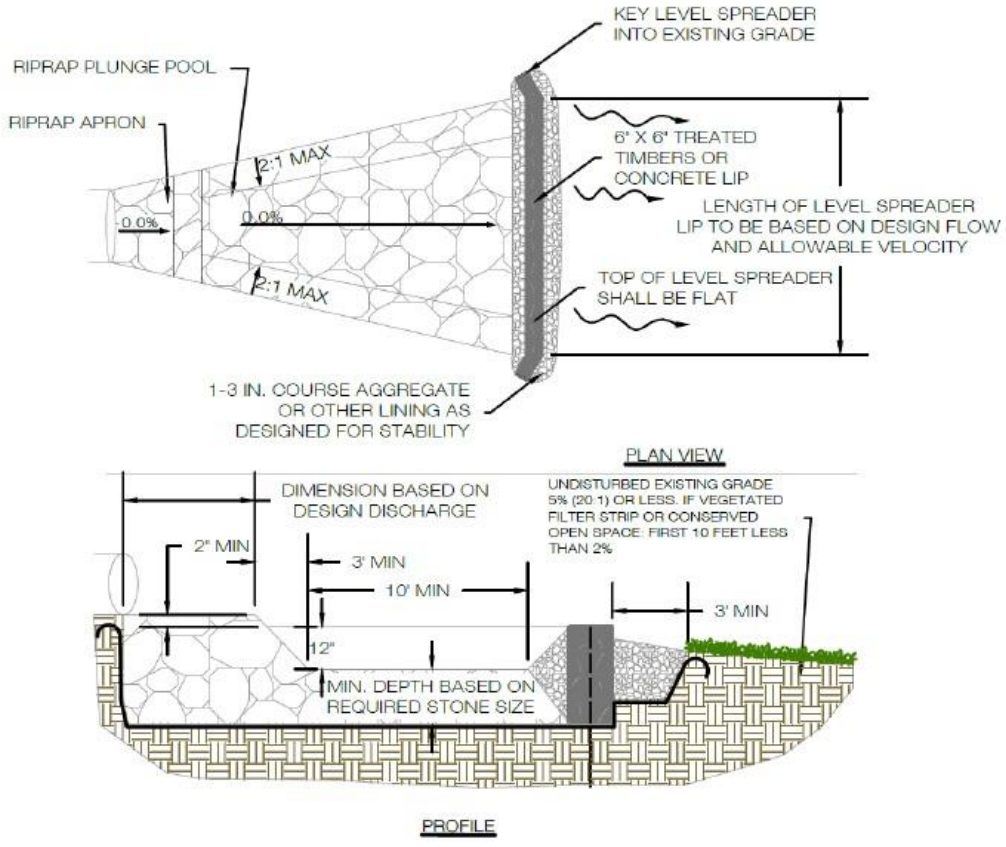
Parameter	< 33 % Impervious		Between 34 % and 66 % Impervious		>66 % Impervious		Notes
Slope	<2%	>2%	<2%	>2%	<2%	>2%	Max. = 4%
Minimum Length (feet)	25	40	30	45	35	50	Multiple by CDA acreage

Engineered Level Spreader with Forebay

An engineered level spreader is an energy dissipater device that is used to convert concentrated stormwater runoff to sheet flow. A forebay is constructed to allow sediment to settle from the incoming stormwater runoff before it is delivered to the treatment or control practice. The engineered level spreader should be located at each point of concentrated incoming flow of the stormwater BMP. Storm drain piping or other conveyances may be aligned to discharge into one forebay or several, as appropriate for the particular site. Engineered level spreaders should be installed in a location which is accessible by maintenance equipment.

The following are design guidelines for using an engineered level spreader with forebay:

- The length of the level spreader lip shall be 10 feet per every 1 cfs of the contributing 10-year peak flow.
- The width of the level spreader channel on the up-stream side of the level lip should be three times the diameter of the inflow pipe, and the depth should be 9 inches or one-half the culvert diameter, whichever is greater.
- The level spreader lip may be set at the treatment volume elevation if no other pretreatment is provided and velocities are non-erosive.
- The forebay section of the level spreader shall be excavated as shown below.
- The forebay should be sized to hold 0.25 inches of runoff per impervious acre of contributing drainage area, with a minimum of 0.1 inches per impervious acre.



Level Spreader: Pipe or Channel Flow to Treatment or Control measure (Va. DCR Stormwater Design Specification No. 2: Sheet Flow to Filter or Open Space).

Appendix C – Reportable Measures for Crediting Urban BMPs for Chesapeake Bay Recovery Efforts

Overview:

Sheets 1 provides more specific information on all of the urban BMPs approved for Chesapeake Bay recovery efforts, including practice name, practice codes, specific spatial and temporal requirements, BMP definitions/descriptions, and web sources of Virginia-specific specifications for these urban BMPs. Sheet 2 catalogues land use code information. Sheet 3 is the Project Tracking Document for the Program.

Sheet 1 – Measures

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Bioretention Filter	912	Drainage Area				10	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. Underdrain existence and hydrologic soil group are unknown for this BMP, which reduces its pollution reduction credits. Some of the characteristics of this standard form includes a required filter media depth of only 24 inches and at least 75% planting coverage within 2 years.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Bioretention Filter — Enhanced	912E	Drainage Area				10	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. Underdrain existence and hydrologic soil group are unknown in this BMP, which reduces its pollution reduction credits. Some of the characteristics of this enhanced form includes a required filter media depth of at least 36 inches, sub-soil testing, and at least 90% planting coverage within 2 years.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(2)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Bioretention Filter - on A/B Soils	912A	Drainage Area				10	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Bioretention Filter - w/ Underdrain, on A/B Soils	912AU	Drainage Area				10	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Bioretention Filter - w/ Underdrain on C/D Soils	912C	Drainage Area				10	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in C or D soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Catch Basin	901	Drainage Area			No. Installed	15	Typically a grate or curb inlet structure and a sump to capture sediment, debris, and pollutants.	-
Urban	Catch Basin — Oil	902	Drainage Area			No. Installed	15	Typically a grate or curb inlet structure and a sump to capture sediment, debris, and pollutants. This BMP includes an insert for capturing oil and grease.	-
Urban	Catch Basin - Sand	903	Drainage Area			No. Installed	15	Typically a grate or curb inlet structure and a sump to capture sediment, debris, and pollutants. This BMP includes filters for capturing sand.	-
Urban	Catch Basin-Leaching	051	Drainage Area			No. Installed	15	Typically a grate or curb inlet structure and a sump to capture sediment, debris, and pollutants. This BMP permits the infiltration of water into the ground through the basin.	-
Urban	Concrete Grid	904	Area Treated				35	The use of concrete grid at the surface to allow for stormwater infiltration. Assumed to be on soils in the A/B hydrologic soil group and without an underdrain.	
Urban	Conserved Open Space	UR-3	Drainage Area				-	Maintaining natural vegetation areas to act as filter strips by accepting sheet flow from adjacent hardened sufaces.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Sheetflow to Filter Areas and Conserved Open Space

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Constructed Wetland	911	Drainage Area				35	Creation of a wetland for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Some characteristics that differ from the enhanced form include a single cell, possible extended detention, a mean wetland depth greater than 1 foot, comprises in area less than 3% of the contributing drainage area, and is an emergent wetland design.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Constructed Wetland(1)
Urban	Constructed Wetland — Enhanced	911E	Drainage Area				35	Creation of a wetland for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. This enhanced form is multi-cell and allows only limited water surface fluctuations, has a mean wetland depth less than 1 foot, comprises in area greater than 3% of the contributing drainage area, and is a mixed wetland design.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Constructed Wetland(2)
Urban	Dirt & Gravel Road - E&S Control	DGRUA		Length of Roadway Treated			1	Reducing sediment runoff from dirt and gravel roads through the use of driving surface aggregates (DSA) such as durable and erosion resistant road surface and raising road elevation to restore natural drainage patterns.	
Urban	Dirt & Gravel Road - E&S Control and Outlets	DGRUE		Length of Roadway Treated			1	Reducing sediment runoff from dirt and gravel roads through the use of driving surface aggregates (DSA) such as durable and erosion resistant road surface and through the use of additional drainage outlets (creating new outlets in ditchline to reduce channelized flow).	
Urban	Dirt & Gravel Road - Outlets Only	DGRUO		Length of Roadway Treated			5	Reducing sediment runoff from dirt and gravel roads through the use of additional drainage outlets (creating new outlets in ditchline to reduce channelized flow).	
Urban	Dry Pond	905D	Drainage Area				35	Depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms.	-

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Dry Swale	907	Drainage Area				10	Dry swales are bioretention cells that are shallower, configured as linear channels, and covered with turf or other surface material (other than mulch and ornamental plants). They operate as a soil filter system that temporarily stores and then filters stormwater. Unlike the enhanced form, this BMP can have a swale slope of up to 2%, as little as 18 in. of media depth, and a turf cover. It must have an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Dry Swale(1)
Urban	Dry Swale - Enhanced	907E	Drainage Area				10	Dry swales are bioretention cells that are shallower, configured as linear channels, and covered with turf or other surface material (other than mulch and ornamental plants). They operate as a soil filter system that temporarily stores and then filters stormwater. This enhanced form must have a swale slope of 1% or less, up to 24 in. of media depth, and trees and shrubs along with the turf cover. Options exist that do not require an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Dry Swale(2)
Urban	Dry Well	UR-9	Drainage Area			No. Installed	15	On-lot infiltration systems for infiltration at the individual lot level, controlling runoff at its source. These systems generally receive sheet flow runoff.	-
Urban	Extended Detention Pond	905	Drainage Area				35	Depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. They have an extended duration of detention in comparison to dry detention ponds, theoretically improving treatment effectiveness. Unlike the enhanced form, this BMP only requires a minimum of 15% of the treatment volume to be in the permanent pool, can have vertical fluctuations > 4 feet, requires an average extended detention time of 24 hours or less, can have a turf cover, and a contributing drainage area < 10 acres.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Extended Detention Ponds(1)
Urban	Extended Detention Pond — Enhanced	905E	Drainage Area				35	Depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. They have an extended duration of detention in comparison to dry detention ponds, theoretically improving treatment effectiveness. This enhanced form includes multiple cells, requires a minimum of 40% of the treatment volume to be in the permanent pool, has a vertical fluctuation under 4 feet, requires an average extended detention time of at least 36 hours, includes trees and wetlands in the plantings, and a contributing drainage area > 10 acres.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Extended Detention Ponds(2)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Filter Strip	393	Drainage Area				10	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. This BMP is an above ground structure. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Sheetflow to Filter Areas and Conserved Open Space
Urban	Filtration Basin	906	Drainage Area				10	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. This BMP is a surface depression structure. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit. Unlike the enhanced form, this BMP is a one cell design with a sand media only whose contributing drainage area contains pervious area.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Filtering Practice(1)
Urban	Filtration Basin — Enhanced	906E	Drainage Area				10	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. This BMP is a surface depression structure. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit. This enhanced form is a two cell design having sand media with an organic layer and a contributing drainage area that is almost 100% impervious.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Filtering Practice(2)
Urban	Grassed Swale	907	Drainage Area				10	A grassed open channel design BMP with treatment through the soil to improve load reduction. A bioswale is designed to function as a bioretention area. Unlike the enhanced form, this BMP can have a swale slope of up to 2%, as little as 18 in. of media depth, and a turf cover. It must have an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Dry Swale(1)
Urban	Grassed Swale — Enhanced	907E	Drainage Area				10	A grassed open channel design BMP with treatment through the soil to improve load reduction. A bioswale is designed to function as a bioretention area. This enhanced form must have a swale slope of 1% or less, up to 24 in. of media depth, and trees and shrubs along with the turf cover. Options exist that do not require an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Dry Swale(2)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Green Roof System — Extensive	011EX	Treated Roof Area				-	A vegetated roof surface that typically consist of waterproofing and drainage materials and an engineered growing media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growing media before it is conveyed into the storm drain system. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. An extensive vegetated roof typically has shallower growing media (2 to 6 inches thick), which is planted with carefully selected drought tolerant vegetation.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Vegetated Roofs(1)
Urban	Green Roof System — Intensive	011IN	Treated Roof Area				-	A vegetated roof surface that typically consist of waterproofing and drainage materials and an engineered growing media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growing media before it is conveyed into the storm drain system. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. An intensive vegetated roof has a deep growing media layer (6 inches to 4 feet thick), which is planted with a wider variety of plants, including trees.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Vegetated Roofs(2)
Urban	Infiltration Basin	908	Drainage Area				5	A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins, because by definition they provide complete infiltration. Unlike the enhanced form, this BMP requires at least two forms of pre-treatment and a soil infiltration rate between 1/2 to 1 in./hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(1)
Urban	Infiltration Basin — Enhanced	908E	Drainage Area				5	A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins, because by definition they provide complete infiltration. This enhanced form requires at least three forms of pre-treatment and a soil infiltration rate of 1.0 to 4.0 in/hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(2)
Urban	Infiltration Ditches	753	Drainage Area				15	A constructed ditch where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration ditches, because by definition they provide complete infiltration. Unlike the enhanced form, this BMP requires at least two forms of pre-treatment and a soil infiltration rate between 1/2 to 1 in./hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(1)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Infiltration Ditches — Enhanced	753E	Drainage Area				15	A constructed ditch where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration ditches, because by definition they provide complete infiltration. This enhanced form requires at least three forms of pre- treatment and a soil infiltration rate of 1.0 to 4.0 in/hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(2)
Urban	Infiltration Trench	909	Drainage Area				10	A constructed trench where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration trenches, because by definition they provide complete infiltration. Unlike the enhanced form, this BMP requires at least two forms of pre-treatment and a soil infiltration rate between 1/2 to 1 in./hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(1)
Urban	Infiltration Trench — Enhanced	909E	Drainage Area				10	A constructed trench where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration trenches, because by definition they provide complete infiltration. This enhanced form requires at least three forms of pre- treatment and a soil infiltration rate of 1.0 to 4.0 in/hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(2)
Urban	Leaching Basin	UR-5	Drainage Area				5	A catch basin like structure for trapping sediment and water that promotes the water to infiltrate into surrounding soil. Often on a bed of stone. Unlike the enhanced form, this BMP requires at least two forms of pre-treatment and a soil infiltration rate between 1/2 to 1 in./hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(1)
Urban	Leaching Basin — Enhanced	UR-5E	Drainage Area				5	A catch basin like structure for trapping sediment and water that promotes the water to infiltrate into surrounding soil. Often on a bed of stone. This enhanced form requires at least three forms of pre- treatment and a soil infiltration rate of 1.0 to 4.0 in/hr.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Infiltration(2)
Urban	Lined Waterway or Outlet	468		Length Treated			15	A waterway or outlet having an erosion-resistant lining of concrete, stone, synthetic turf reinforcement fabrics, or other permanent material	-
Urban	Mulches, Blankets, and Mats	UR-8	Area Treated				1	The application of organic materials to provide a temporary, protective soil cover. They can be applied as pre-made blankets or loose as mulch.	-
Urban	Nutrient Management (Urban/Residential)	UR-7	Area Implemented				1	Urban nutrient management involves the reduction of fertilizer to grass lawns and other urban areas. The implementation of urban nutrient management is based on public education and awareness, targeting suburban residences and businesses, with emphasis on reducing excessive fertilizer use.	

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Permeable Pavers — Enhanced	910E	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. Underdrain, sand, and vegetation existence and hydrologic soil group are unknown for this BMP, which reduces its pollution reduction credits. The enhanced form of this BMP requires soil infiltration rates to exceed 0.5 in./hr., has a contributing drainage area equal to the permeable pavement area, and has options to not require an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html_PermeablePavement(2)
Urban	Permeable Pavers - on A/B Soils	910A	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, no sand or vegetation and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html_PermeablePavement(1)
Urban	Permeable Pavers - w/ Sand, Veg, on A/B Soils	910A2	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, has sand and/or vegetation and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html_PermeablePavement(1)
Urban	Permeable Pavers - w/ Sand, Veg, Underdrain, on A/B Soils	910A3	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html_PermeablePavement(1)
Urban	Permeable Pavers - w/ Sand, Veg, Underdrain, on C/D Soils	910C3	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in C or D soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html_PermeablePavement(1)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Permeable Pavers - w/ Underdrain on A/B Soils	910A1	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Permeable Pavement(1)
Urban	Permeable Pavers - w/ Underdrain on C/D Soils	910C1	Area Treated				25	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in C or D soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Permeable Pavement(1)
Urban	Pet Waste Management	1005				Lbs Waste Managed	1		-
Urban	Planter Boxes	071	Contributing Impervious Surface Area			No. Structures	10	Small landscaped stormwater treatment devices that can be placed above or below ground and can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality, similar to rain gardens and green roofs but smaller in size.	-
Urban	Porous Pavement	910	Area Treated				30	A variety of permeable pavement surfaces including pervious concrete, porous asphalt and permeable interlocking concrete pavers. All permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom. Unlike the enhanced form, this BMP only requires soil infiltration rates less than 0.5 in./hr., an external contributing area to permeable pavement ratio not exceeding 2:1, and does not require an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Permeable Pavement(1)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Porous Pavement — Enhanced	910E	Area Treated				30	A variety of permeable pavement surfaces including pervious concrete, porous asphalt and permeable interlocking concrete pavers. All permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom. The enhanced form of this BMP requires soil infiltration rates to exceed 0.5 in./hr., has a contributing drainage area equal to the permeable pavement area, and has options to not require an underdrain.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Permeable Pavement(2)
Urban	Raingarden/ Bioretention Basin	0009	Drainage Area			No. Systems	8	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. Underdrain existence and hydrologic soil group are unknown for this BMP, which reduces its pollution reduction credits.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Raingarden/ Bioretention Basin - on A/B Soils No Underdrain	0009N	Drainage Area			No. Systems	8	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Raingarden/ Bioretention Basin - w/ Underdrain on A/B Soils	0009A	Drainage Area			No. Systems	8	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)
Urban	Raingarden/ Bioretention Basin - w/ Underdrain on C/D Soils	0009C	Drainage Area			No. Systems	8	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in C or D soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(1)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Raingarden/Bioretention Basin — Enhanced	0009E	Drainage Area			No. Systems	8	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. Underdrain existence and hydrologic soil group are unknown for this BMP, which reduces its pollution reduction credits. This enhanced form requires a filter media depth of at least 24 inches, sub-soil testing, a grass filter strip, and a greater variety of vegetation types.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Bioretention(2)
Urban	Rainwater Harvesting — Barrels	708B	Contributing Impervious Surface Area			No. Installed	20	Rain barrels harvest rainwater for reuse. They are placed outside a building at roof downspouts to store rooftop runoff for later reuse in lawn and garden watering. Rain barrels can be implemented without the use of pumping devices by relying on gravity flow instead.	http://www.metrocouncil.org/environment/Water/bmp/ Rain Barrels
Urban	Rainwater Harvesting — Cistern	708	Contributing Impervious Surface Area			No. Installed	15	Cisterns harvest rainwater for reuse in significantly larger volumes than rain barrels. They use manufactured tanks or underground storage areas. Rainwater collected in cisterns may be used for lawn and garden watering and also in non-potable water applications such as toilet flushing. Cisterns can be implemented without the use of pumping devices by relying on gravity flow instead.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Rainwater Harvesting
Urban	Retention Basin	913	Drainage Area				35	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Unlike the enhanced form, this BMP has a single pond cell and a length/width ratio or flow path of 2:1 or more.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Pond(1)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Retention Basin — Enhanced	913E	Drainage Area				35	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. This enhanced form may have multiple cells, a length/width ratio or flow path of 3:1 or more, wetlands for more than 10% of the pond area, pond landscaping to discourage geese, and aeration.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Pond(2)
Urban	Riparian Forest Buffer	391U	Buffer Area		Avg Buffer Width		15	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals.	-
Urban	Roof Runoff Management	724	Contributing Impervious Surface Area				15	This strategy involves managing runoff close to its source by intercepting, infiltrating, filtering, treating or reusing it as it moves from the impervious surface to the drainage system. Rooftop impervious surface flows can be directed to pervious areas or to alternative runoff reduction practice(s) adjacent to the roof.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Rooftop Disconnection
Urban	Rooftop Disconnection	724	Contributing Impervious Surface Area				15	This strategy involves managing runoff close to its source by intercepting, infiltrating, filtering, treating or reusing it as it moves from the impervious surface to the drainage system. Rooftop impervious surface flows can be directed to pervious areas or to alternative runoff reduction practice(s) adjacent to the roof.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Rooftop Disconnection
Urban	Sediment Basin/Trap	350	Basin Area				20	A basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two. Sediment basins capture and detain sediment laden runoff, or other debris for a sufficient length of time to allow it to settle out in the basin.	-

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Sediment Forebay	052	Forebay Area				15	A sediment forebay is a settling basin or plunge pool constructed at the incoming discharge points of a stormwater BMP. Their purpose is to allow sediment to settle from the incoming stormwater runoff before it is delivered to the balance of the BMP. A sediment forebay helps to isolate the sediment deposition in an accessible area, which facilitates BMP maintenance efforts.	http://dcr.cache.vi.virginia.gov/stormwater_management/Sediment Forebay
Urban	Stormwater Planter	071	Contributing Impervious Surface Area			No. Structures	10	Small landscaped stormwater treatment devices that can be placed above or below ground and can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality, similar to rain gardens and green roofs but smaller in size.	-
Urban	Stormwater Wetland	911	Drainage Area				35	Creation of a wetland for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Some characteristics that differ from the enhanced form include a single cell, possible extended detention, a mean wetland depth greater than 1 foot, comprises in area less than 3% of the contributing drainage area, and is an emergent wetland design.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Constructed Wetland(1)
Urban	Stormwater Wetland — Enhanced	911E	Drainage Area				35	Creation of a wetland for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. This enhanced form is multi-cell and allows only limited water surface fluctuations, has a mean wetland depth less than 1 foot, comprises in area greater than 3% of the contributing drainage area, and is a mixed wetland design.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Constructed Wetland(2)

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Stream Restoration (Urban)	SR-U		Length Restored			-	Stream restoration in urban areas is used to restore the urban stream ecosystem by restoring the natural hydrology and landscape of a stream, help improve habitat and water quality conditions in degraded streams.	
Urban	Street Sweeper	1002	Area Treated			Pounds Collected	-	Street sweeping measured by the weight of street residue collected.	-
Urban	Surface Sand Filter	906S	Drainage Area				10	Practices that capture and temporarily store runoff and pass it through a filter bed of sand. This BMP is an above ground structure.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Filtering Practice(1)
Urban	Tree/Shrub Establishment	612	Area Planted				15	Urban tree planting is planting trees on urban pervious areas at a rate that would produce a forest-like condition over time. The intent of the planting is to eventually convert the urban area to forest. If the trees are planted as part of the urban landscape, with no intention to covert the area to forest, then this would not count as urban tree planting	-
Urban	Underground Filter	UR-6	Drainage Area				10	This filtering practice is modified to install the filtering components underground and is often designed with an internal flow splitter or overflow device that bypasses runoff from larger stormwater events around the filter. Unlike the enhanced form, this BMP is a one cell design with a sand media only whose contributing drainage area contains pervious area.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Filtering Practice(1)
Urban	Underground Filter — Enhanced	UR-6E	Drainage Area				10	This filtering practice is modified to install the filtering components underground and is often designed with an internal flow splitter or overflow device that bypasses runoff from larger stormwater events around the filter. This enhanced form is a two cell design having sand media with an organic layer and a contributing drainage area that is almost 100% impervious.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Filtering Practice(2)
Urban	Vegetated Open Channel	082	Drainage Area				15	Vegetated open channels that convey stormwater runoff and provide treatment as the water is conveyed. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. Underdrain existence and soil hydrologic group are unknown for this BMP, which reduces its pollution reduction credits.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Grass Channel
Urban	Vegetated Open Channel - on A/B Soils	082A	Drainage Area				15	Vegetated open channels that convey stormwater runoff and provide treatment as the water is conveyed. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Grass Channel

Type	BMP Name	Practice Code	Practice Area Measure	Practice Length Measure	Practice Width Measure	Count Measure	Service Years	BMP Definition	VA Specifications
Urban	Vegetated Open Channel - on C/D Soils	082C	Drainage Area				15	Vegetated open channels that convey stormwater runoff and provide treatment as the water is conveyed. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in C or D soil.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Grass Channel
Urban	Wet Pond	913	Drainage Area				35	Creation of a pond for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Unlike the enhanced form, this BMP has a single pond cell and a length/width ratio or flow path of 2:1 or more.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Pond(1)
Urban	Wet Pond - Enhanced	913E	Drainage Area				35	Creation of a pond for intercepting stormwater runoff then releasing it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. This enhanced form may have multiple cells, a length/width ratio or flow path of 3:1 or more, wetlands for more than 10% of the pond area, pond landscaping to discourage geese, and aeration.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Pond(2)
Urban	Wet Swale	066	Drainage Area				10	Vegetated open channels that convey stormwater runoff and provide treatment as the water is conveyed. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil. Unlike the enhanced form, this BMP slopes less than 2%, is an on-line design, and has only a turf cover.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Swale(1)
Urban	Wet Swale - Enhanced	066E	Drainage Area				10	Vegetated open channels that convey stormwater runoff and provide treatment as the water is conveyed. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil. This enhanced form has swale slopes less than 1%, off-line swale cells, with wetland planting and trees within swale cells.	http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html Wet Swale(2)

Sheet 2 – Land Use

Existing Land Use Code Info		
Existing Land Use	**LU Code**	**Definition**
Ag (unspecific)	Agric	Farmets, mixed uses, indiscernible
Ag - Pasture/Hay	81	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle.
Ag - Hay+Alfalfa	HayAl	Areas of hay crop that include alfalfa.
Ag - Pasture Only	Past	Areas of grasses planted for livestock grazing, typically on a perennial cycle.
Ag - Row+Hay	RowHa	Areas of row crops that include hay crop.
Ag - Row Crops Only	82	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton. Crop vegetation accounts for greater than 20% of total vegetation.
Ag - Small Grains	83	Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
Ag — Fallow	84	Areas used for the production of crops that do not exhibit visible vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.
Orchards/Vineyards/Other	61	Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
Urban (unspecific)	Urban	mixed uses, undiscernible
Urban - Low Intensity Residential	21	Areas of mixed constructed materials (30-80% of cover) and vegetation (20-70% of cover). These areas commonly include single-family housing units in areas of lower population densities.
Urban - High Intensity Residential	22	Highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to100 percent of the cover.
Urban - Commercial/Industrial/Transportation	23	Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.
Urban/Recreational Grasses	85	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
Forest - Deciduous	41	Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.

Existing Land Use Code Info		
Existing Land Use	**LU Code**	**Definition**
Forest - Evergreen	42	Areas dominated by trees where more than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Forest — Mixed	43	Areas dominated by trees where neither deciduous nor evergreen species are greater than 75% of total tree cover.
Open Water	11	Areas of open water, generally with less than 25% cover of vegetation or soil.
Wetlands - Woody	91	Areas where forest or shrubland vegetation accounts for greater than 24% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Wetlands - Emergent Herbaceous	92	Areas where perennial herbaceous vegetation accounts for greater than 74% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Shrubland	51	Areas dominated by shrubs (< 5 meters tall) with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Grasslands/Herbaceous	71	Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
Bare Rock/Sand/Clay	31	Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
Quarries/Strip Mines/Gravel Pits	32	Areas of extractive mining activities with significant surface expression.
Transitional	33	Areas of sparse vegetative cover (< 25 percent) that are dynamically changing from one land cover to another, often because of land use activities such as forest clearcuts, a forest-ag transition, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).

Sheet 3 – VCAP Project Tracking Document

Data Reporting Fields				
Field	**Required?**	**Description, purpose, and rules associated with the field**	**Example 1**	**Example 2**
Date Installed	Yes	Report the **year** the practice was installed.	2003	5/30/2003
BMP Name	Yes	Report the **practice name** either using Chesapeake Bay Program practice names, state practice names or facility-specific practice names.	TCN – Tree planting	RG
Practice Description	Yes	Report a description of what the BMP does or a definition.	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water…	Small-Scale Bioretention implanted at the end of a downspout with no underdrain and using native soils. Landscaping is native plants…
Contributing Drainage Area	Yes, if 'Amount Applied' is not supplied	Report total site acres treated by the practice; includes the Impervious Acres.	N/A	0.1
Impervious Acres Treated	Optional	Report the number of impervious acres treated by the practice. If unknown or left blank, DEQ will assume the Total Acres Treated are 100% pervious urban.	N/A	0.1
Runoff Captured	Optional	If the BMP meets Virginia's performance-based water quality criteria, calculate the runoff captured in acre-feet.		
Amount Applied	Yes, if 'Contributing Drainage Area' is not supplied	Report the number of units implemented for each practice at the location.	0.5	N/A
Measurement Unit	Yes, if 'Amount Applied' is supplied	Report the unit of measurement for the value entered under "Amount Applied." Most common measurement units will be acres, linear feet, or pounds.	Acres	N/A

County Name	Yes	Report the name of the country in which the practice was implemented.	Culpeper	Farmville
State FIPS	Optional	Report State FIPs code where the practice was installed.	51087	51087
HUC12	Yes	Report HUC12 where the practice was installed, if available.	20802060105	20802060105
Latitude	Yes	Report latitude of practice, if applicable or available. If latitude and longitude are provided HUC12 and State FIPs are unnecessary.	DDD MM' SS.S"	DDD MM' SS.S"
Longitude	Yes	Report longitude of practice, if applicable or available. If latitude and longitude are provided HUC12 and State FIPs are unnecessary.	DDD MM' SS.S"	DDD MM' SS.S"
Inspect Date	Yes	Report each inspection date (i.e. Spot Check date) for the practice. If more than 5 inspections have been performed for a given practice, insert additional columns to accommodate.	2003, OR 5-30-2007	
District Approval Date	Yes	Report the date the allocation was approved by the District Boards.	1/1/2012	5/15/2014
Grant Source	Yes	Report the grant source providing funding. If multiple grants, insert additional columns to accommodate.	NFWF	WQIF
Contract Number	Yes	Report the unique District identification number.	CulpeperSWCD-FY15001	PiedmontSWCD – FY14005

Appendix D – VCAP Forms

VCAP Form-1: Application
VCAP Form-2: Job Sheet
VCAP Form-3: Landowner Agreement
VCAP Form-4: Transfer of Responsibility
VCAP Form-5 Liability Release

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

CONTRACT
VCAP Form – 1

Part A. Application

I, _____ (PRINT) hereby make application to_____Soil & Water Conservation District for cost-share assistance to purchase and install a best management practice as described in part B below.

I /We agree that the best management practice(s) approved will be installed, operated, and maintained in accordance with the practice(s) standard(s) found in the VCAP manual and the Landowner Agreement (VCAP Form – 3). I/We agree not to use the BMP for purposes of Nutrient Trading or regulatory compliance. I/We shall indemnify and save the District harmless from any and all claims for damages to persons or property arising from the installation, maintenance, repair, operation or use of the BMP(s).

I/We understand that it is my/our responsibility to pay in full all bills for work completed under this agreement prior to submission of eligible bills for reimbursement.

Applicant Signature:	Directions to site:
Mailing Address:	
County:	
Phone: Cell:	
Email:	
SSN / Tax ID:	Circle one: Landowner / Manager /Other

The local Soil and Water Conservation District (SWCD) is required to issue a 1099-MISC to the Internal Revenue Service (IRS) for any individual to whom it issues a check for over $600.00. Because the IRS uses the Social Security number or Federal Tax ID number as a unique identifier, the SWCD requires the applicant to complete an IRS W9 form. The SWCD does not use the Social Security number or Federal Tax ID number for any purpose other than that stated above.

Part B. Technical Determination and District Approval **(to be filled out by District Staff)**

Practice Title	Quantity	Total Estimated Cost	Approved Estimated Cost-Share	Required Completion

Job Sheet Attachment (VCAP Form-2): Yes/No Supporting Documentation: Yes/No

I have reviewed this application and all supporting documentation, and have indicated the quantity authorized based on technical need. This practice must be installed and certified by the completion date.

X_____

District Employee Signature Date

Application Approval:

X_____

District Director Signature Date

Carryover of this practice is granted to be completed by date: _____ x_____

District Director Signature Date

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

Part C. Best Management Practice Verification

I verify that the above practice was installed according to the applicable practice standards and specifications of the VCAP Manual.

X_____
District / Technical Representative

Date

Payment Amount _____ Date of Payment _____ Check Number _____

Funding Source _____

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

JOB SHEET
VCAP Form – 2

This Job sheet is to be filled out by district technical staff together with program participant. Please document any information that helps to describe any unique aspects of the project. This will assist with spot checks over the life span of the project.

Tracking and Reporting:

Property Owner: _____ Address: _____

Manager (if applicable):_____ Contact: _____

GPS Coordinate: _____ Hydrologic Unit Code: _____

Grant Source: _____ Completion Date: _____

Contributing Drainage Area: _____ Impervious Area Treated: _____

Acres Treated or Quantity, if applicable: _____

Screening Factors for Ranking:

TMDL: Bacteria Sediment Phosphorus Nitrogen No TMDL

Existing BMP: YES NO

Disconnection (distance across pervious surface ≥ 40 ft. and slope ≤ 5 %): YES NO

Drainage/Cover Problem or Hotspot:	YES	NO
Proximity to Waterway:	> 100 ft.	< 100 ft.
Critical Slope (>15%):	YES	NO
Filter Strip or Riparian Buffer:	YES	NO
Depth to Water Table & Bedrock:	> 2 ft.	< 2 ft.
Education Opportunity:	YES	NO

Ownership: PUBLIC PRIVATE ROW

Sketch Layout:

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

Site-Specific Details:

Design Details: i.e. Dimensions, Sizing, Planting Plan (Describe)

Construction and Installation Details: i.e. Materials and Specifications (Describe)

Signage Requirement: i.e. NO MOW/WILDLIFE/EDUCATIONAL (Describe)

Permits: Confirm local policies, such as allowable grass height, mowing requirements, etc. (Describe)

Operation and Maintenance Plan: (Describe)

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

LANDOWNER AGREEMENT

VCAP Form – 3

The _____ Soil and Water Conservation District (District) has agreed to provide funding through a grant from the _____ (*Grant Agreement #*_____) to _____ *(Landowner)* for the purpose of construction of a _____ *(BMP Description)* located at _____ *(Landowner Address or BMP Location)*.

A total amount of $_____ in cost share funding has been approved for this practice. The landowner agrees that access to the landowner's property will be allowed for the District to:

- Evaluate site and design options, and to observe construction and operation of the BMP.
- Conduct Spot Checks during the ___ year life span of the practice.

Such access to the site shall be secured through consultation with the landowner to determine a mutually agreeable date and time for access.
The landowner accepts responsibility for the maintenance of the BMP for the duration of its project lifespan. The landowner shall be responsible for maintaining the practice in accordance with the attached ***Job Sheet (VCAP Form-2).***

The Landowner may not use the approved BMP for purposes of Nutrient Trading or regulatory compliance.

The Landowner shall indemnify and save the District harmless from any and all claims for damages to persons or property arising from the installation, maintenance, repair, operation or use of the BMP(s).

Any breach of the above terms of this agreement shall lead to the immediate revocation of this agreement. All or part of funding assistance may be required to be refunded, on a straight line pro-rata basis based on the BMP lifespan, if the BMP is removed or not properly maintained during the life of the practice. Should the property change ownership during the life span of the practice, the landowner will work with the District to ensure that an ***Agreement Transferring BMP Responsibility (VCAP Form-4)*** form is completed. If the VCAP Form-4 is not completed, the applicant remains responsible for the BMP during the project lifespan.

_____ _____
Landowner Date

_____ _____
District Representative Date

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

Agreement Transferring BMP Responsibility
VCAP Form – 4

Commonwealth of Virginia

AGREEMENT TRANSFERRING RESPONSIBILITY FOR BEST MANAGEMENT PRACTICE

This agreement is intended to designate the transfer of maintenance responsibility for a Best Management Practice that received cost-share. The present participant of the property has received funding from the Commonwealth of Virginia to implement a Best Management Practice on the below-referenced land unit. In return he/she has agreed to maintain the practice until_____. Completion of this agreement acknowledges assumption of responsibility by the new participant, including the requirement to repay cost-share funds received by the present participant if the BMP is not maintained according to state specifications or in accordance with the Operations and Maintenance Plan described in the Job Sheet.

Contract No.: _____ Name of Soil and Water Conservation District: _____

Latitude: _____ Longitude: _____

BMP description (if applicable):_____

Extent Installed: _____

PRESENT PARTICIPANT-NAME & ADDRESS	NEW PARTICIPANT-NAME & ADDRESS
_____	_____
_____	_____
_____	_____
Phone No.:_____	Phone No.:_____

The undersigned hereby certifies that the present participant has transferred to the new participant his or her right and interest in the land unit described above. In consideration of this transfer of ownership or leasehold, it is hereby agreed:

1. The new participant hereby assumes the duties and obligations of the present participant under Contract No.:_____ to maintain the above BMP for its lifespan in accordance with state specifications or the assigned Operation and Maintenance Plan described in the Job Sheet, and to refund all or part of the cost-share assistance or other provided funding if the practice is found not to meet state specifications, or if the practice is removed or not properly maintained during its lifespan. The new participant agrees to allow District personnel access to his/her property for the purpose of verifying maintenance of BMP.
2. The District acknowledges the transfer of the maintenance responsibility. Any cost-sharing or assistance provided under this transfer agreement shall be in accordance with applicable program rules and regulations.

_____	_____
(SIGNATURE OF PRESENT PARTICIPANT)	(SIGNATURE OF NEW PARTICIPANT)
_____	_____
DATE	DATE
_____	_____
SSN or Federal Tax ID#	SSN or Federal Tax ID#

District Board APPROVED BY: _____ DATE: _____

Virginia Conservation Assistance Program (VCAP)

Contract Number:_____

Liability Release Agreement for Rainwater Harvesting Projects
VCAP Form -5

PLEASE READ CAREFULLY BEFORE SIGNING

Effective Date: _____

I, _____ (*please print clearly*),
wish to forgo a licensed, engineered design and as-built certification as required by the Virginia Conservation Assistance Program Manual for the Rainwater Harvesting project,
located at _____, funded by the
_____ District (the District).

I agree to the following:

- I hereby acknowledge I have read the DCR Stormwater Management Design Specification No. 6, and the design plan submitted and accepted by the District is in accordance with the technical design details in the DCR specification.

- I hereby acknowledge the Rainwater Harvesting system will be built to the design plan accepted by the District and in accordance with any manufacturing instructions.

- I hereby release from all liability and hold harmless the District, any of its employees representing or related to the District, and any volunteers or other representatives, for any personal injuries, including death, property loss, or damage in connection with any activity related to the Rainwater Harvesting project located at the location stated above.

- I hereby agree to abide by all rules, regulations, and safety provisions that are presented by the District, the contractor or the manufacturer.

This contract shall be governed by the Commonwealth of Virginia in the County of _____ and any applicable Federal law.

_____ _____
Signature of Participant Date Signature of District Representative Date

_____ _____
Printed Name Printed Name